DOCUMENT RESUME

ED 193 047 SE 032 946

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TITLE	Exploitation or Conservation: Today's Choices for Tomorrow. A Guide to Activities and Strategies in Environmental Education, Grades 9-12.
INSTITUTION	Alachua County Schools, Gainesville, Fla.
SPONS AGENCY	Florida State Dept. of Education, Tallahassee. Office of Environment Education.
PUB DATE	Aug 77
NOTE	244p.: Contains occasional light and broken type.
EDRS PRICE	MF01/PC10 Plus Postage.
DESCRIPTORS	*Biology: *Environmental Education; Interdisciplinary Approach: *Natural Resources: Physical Sciences: *Pollution: Resource Units: Science Instruction: Secondary Education: Secondary School Science: *Social Studies
IDENTIFIERS	Environmental Problems: Environmental Quality

ABSTRACT

Presented in this guide are classroom and outdoor lessons intended to assist high school teachers in implementing environmental education objectives. Provided for each objective are background information, up to 15 related activities, and teacher questions designed to facilitate students' investigations. Among the learning strategies used are role-playing, field studies, library research, and interviews of local residents. Emphasis is upon data collection and discussion by students. The student's role in natural and social environments is stressed in most activities. (Author/WB)

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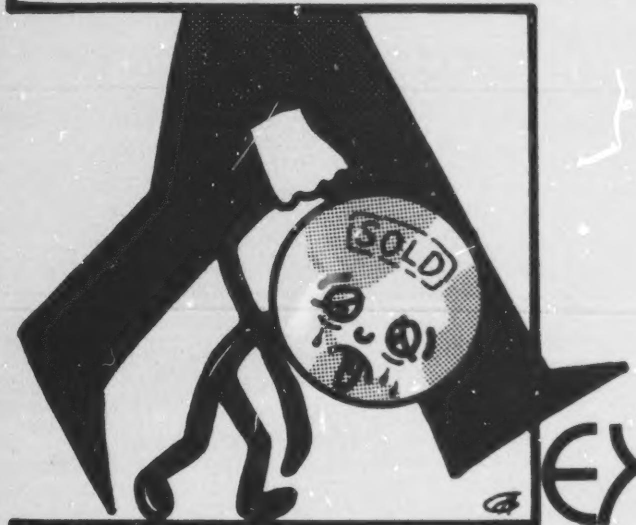
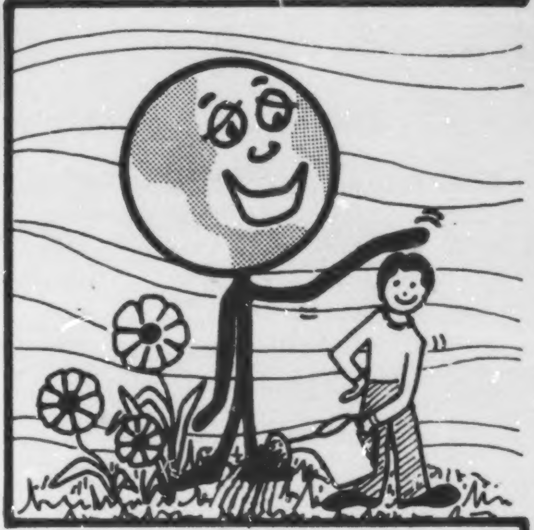


EXPLOITATION OR CONSERVATION



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Today's choices for tomorrow.

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EXPLOITATION OR CONSERVATION:
TODAY'S CHOICES FOR TOMORROW

A Guide to Activities and Strategies in Environmental Education

9 - 12

The activities and strategies in this guide have been compiled to direct and assist you in implementing the high school environmental education objectives.

The teaching of environmental education is absolutely essential to insure that our "near voting age" students can critically appraise and responsibly decide future issues concerning the environment and their implications. As each student understands his role in the natural and social environment, he enhances not only his own chances for survival, but also those of future generations as well.

The efforts of this writing team were funded through an environmental "mini-grant" from the Department of Education, State of Florida.

We extend our special thanks to James Phillips, Regional II Consultant, Office of Environmental Education, State of Florida.

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August 1977

ENVIRONMENTAL CONCEPTS

The earth is a vast but limited natural system.

The total environment is in constant change.

A living thing is the product of its heredity and environment.

All living things, including man, are interdependent with one another and with their environment.

OBJECTIVE:

To identify, describe and construct the interrelationships of the biotic and abiotic environments within the local environment.

Background: The interrelationship of all living things to one another has been a basic assumption derived from the biological study of genetics, evolution and social behavior since man began to write down his observations in the form of recorded history.

Biologists can show, too, that living things are not just interrelated, but they are also interdependent.

An analogy might be seen in the web of the fisherman's net. Each mesh is interrelated to those about it and dependent upon others for the support and strength necessary for efficient use in catching fish. If meshes are cut or broken, their loss fails not only themselves, but those that surround them. A point is finally reached when too many meshes are broken and the net can no longer serve its function of catching fish.

So it is in the ecosystem, the system of life, when too many species become extinct, or too many forests, marshes or mangroves are removed, or too much pollution is produced, hindering the living links, the ecosystem is made less efficient or stable, and ultimately runs the risk of breaking down. Remember, man is only one of the meshes in the net, and, while he has the ability to do some repair work, he alone cannot control the workings of the net.

ACTIVITY 1:

To study the changes which a body of water has undergone and the definite steps of land formation and plant growth, take pupils on a field trip to observe changes in a local pond, noting growth of plants, type and size of plants. Have them make inquiries of parents or grandparents about former bog areas that are now covered with plants. To trace the history of a given area, they could consult old topographic maps.

Have students try to predict the age of the pond or bog, by studying the depth of the ooze. Ask students if they can tell why these changes have occurred.

At the pond have students discuss the following questions:

1. How does a pond change to dry land?
2. How long does it take? What determines the length of time?
3. In what ways can you predict the length of time required?
4. What are the stages of succession in a pond? What indications do you see of these stages?
5. How is the animal life of a pond affected by the change?
6. Is soil being formed? How? What makes up the soil being formed?
7. What is the relationship of the availability of soil to plant growth?

Ask other appropriate questions, but supply information to tell what types of plants develop at various stages. Diagrams may also be used to illustrate. This information can be found in: Brown, Robert E., and Mouser, G.W.: Techniques for Teaching Conservation Education.

Students are to be taken on a second field trip to an older pond which supports more plant growth. (Before the field trip, site should be carefully selected.) On this field trip the students should note:

1. Is this pond older than the former? How can you tell?
2. Types of plants as related to soil depth.
3. Animal life supported by plants.
4. Collect leaves from plants for study.
5. Collect water or soil samples. What is the composition of the soil?
6. Record topography, slope, temperature and age of pond.
7. What animals are living on plants at different zones of vegetation?
8. What determines the water-holding capacity of soil?
9. Students may try to calculate the date at which the pond will be completely filled if succession runs its course.

Investigate:

1. What is the composition on the bottom of the pond?
2. How does this determine plant growth?
3. How have natural forces changed wildlife habitat?
4. How is the capacity of the pond to support a particular species of wildlife limited?
5. How does the changing environment at the pond affect the organisms living in and around it?
6. What activities of many may speed up the succession at the pond?
7. What are the effects of soil erosion at the pond?

ACTIVITY 2:

To study how plant life on bare rock undergoes a series of changes and how ultimately a forest or other climax community may grow where there was once only bare rock, take students to an area composed chiefly of rocks, showing both bare rock and those supporting plant growth. Here they take a view of the area and see bare rock, potholes of soil, cracks, and crevices, a variety of plants (lichens - trees). Have them try to account for these wide differences. Allow time to explore a small given area and arouse the curiosity of the pupils.

Discussion in field: Study each different area, discussing plants, soil, moisture, temperature, length of growing season, etc. This may be done according to the amount of soil or types of plants. Perhaps the following outline might be used:

1. Bare rock:
    a. Why do you see only lichens or mosses on the rock?
    b. How do the lichens obtain their nutrients?
    c. How do lichens help to break down the rocks to form soil?
2. Small, shallow bowl of soil in the rock:
    a. Why do you think you find mosses growing here?
    b. Why are they able to survive?

    c. Discuss amount of soil, available water, and growing ability.

3. Large potholes of soil or large crevices filled with soil:
    a. Relate the size of the plants to the amount of soil.
    b. What animals do you find?
4. Area covered with shallow soil:
    a. Why do you find shrubs and small trees here?
5. Area covered with soil to a considerable depth:
    a. Here you find a flourishing forest. Why?
6. Area developed by wind or water erosion and not necessarily rock weathering:
    a. Observe and record observations.

Discuss the following:

1. How long does it require for soil to be formed?
2. How do limiting factors determine the plant growth?
3. How does the availability of soil and moisture limit growth on bare rocks?
4. How is soil formed on bare rocks?
5. What aids in the formation of crevices in the rock surfaces?
6. Compare the size of the different plants found in the various stages in the succession.
7. How long may it require for bare rocks to change to a forest community?
8. When might you expect animals to begin to inhabit this area?
9. What is a Climax Community?
10. How can you tell that it has reached this stage?
11. Will the climax remain stable?

ACTIVITY 3:

To show how various physical factors of the environment limit and help to determine the types of organisms living there, visit an area with a slope or hill which has a noticeable difference in elevation. In an area without hills, you may use several different communities such as a field, swamp, or wooded area. The students are divided into groups and select a recorder to take notes for the group. This field trip involves determining the different communities and driving stakes to identify and label (by numbers) each community. As each community is determined, students should drive stakes to mark each area for future reference.

1. At the start of trip, at the top of the hill ask students what type of plants they see. (Give names, if possible.) What is the nature of the undergrowth? (Give names, if possible.) Are there a great many low-growing plants? Why? Why not? Note as many characteristics of the area as possible. Pick up a handful of soil and note moisture and type. Note depth of decaying leaves on forest floor.

2. As you move to another area, let students help decide when you are in another environment and ask why? How can you tell? (Should be about middle of slope but you should not tell them - must guide them into finding answers and seeing what you want to teach.)

Ask about:

- a. Trees
- b. If on windward side, the effects of the wind on the vegetation
- c. Major or any differences between two areas
- d. Types of plants
- e. Undergrowth
- f. Understory

3. Proceed to the very bottom of the slope, which should be quite different in physical appearance. Here ask questions of the same type as used in other areas, and note as many differences as possible.

1. In lab have students discuss notes made in the field and compile for each community (staked area) a list of the factors of the environment which might influence the plant growth for that area. Combine factors to form one complete list. On one board have students compare lists: perhaps they disagree with you. (You might encourage disagreement.) Then say, well how can we prove who is right? Set up investigations.)

2. Let individuals or groups choose factor for which they want to test. (The number per group will be determined by the number of students and the number of factors. As many factors as time and equipment allow may be measured.)

For information on limiting factors consult Odum, E.P.: Fundamentals of Ecology.

Second field trip: This field trip cannot be completed in one day, but may require as long as a week to complete results. It should be set up at this time (with aid of teacher) and each group should have time to determine results.

In the field, each group chooses the appropriate place and sets up the specific experiment for measuring the limiting factor with which he is dealing. The preparation will require several hours or longer and the teacher's guidance will be necessary.

Laboratory Class: When field experiments have run to completion, calculate and compile results. Here again the teacher's guidance will be essential in helping to compile results. (This phase of the lesson is most important.)

A definite relationship between the limiting factor and the characteristics of each community should be established. Each group should compile relationships from results and in class discussion all relationships should be established. The greatest value of these lessons is to show these relationships.

Third Field Trip: This trip should be to an entirely different area, but should show communities which are unlike each other. Pupils should be able to see the results of many limiting factors. Walk through area and:

1. Discuss different communities.
2. Identify as many plants as possible in each area and account for growth there.
3. Point out limiting factors for plants in each area.
4. What might be the nature of a given community, if a factor such as fire had been present?
5. Predict the type of community that might have developed if certain physical limiting factors had been included or omitted.

Class Discussion: After the third field trip students should make comparisons of limiting factors not found in both areas and try to determine their effects on the given community.

At this time pupils should culminate and integrate the concept of limiting factors as related to communities. Emphasis should be placed on the values of conserving natural resources through the proper control and management of limiting factors.

A discussion of the following is recommended after all field work and labs to fix the concept for each student.

1. What effect does a limiting factor, such as temperature, have upon a given area?
2. What area of a slope receives greatest exposure?
3. How does exposure affect the plants of an area? What type of plants are most likely to grow in an area of greatest exposure?
4. What determines the water-holding capacity of the soil?
5. Why is the rate of evaporation as important as the amount of available water?
6. Why are temperatures and moisture acting together the most important parts of climate?
7. Why is relative humidity a limiting factor?
8. What effect does wind have upon:
    a. Rate of evaporation?
    b. Plants on the windward side of a hill?
    c. Temperature?
9. What effect does vegetation have upon the temperature of an area?
10. Will more energy be absorbed by a forest or a bare field? Why?
11. What type of soil has the greatest water-holding capacity?
12. What zone of the soil contains the most humus?
13. Why can we consider fire a limiting factor?
14. Which community had soil with the greatest amount of humus?
15. Which community contained soil with the highest pH?
16. What limiting factor determines the biomes of the world?

From a discussion of the above questions students should be able to relate these ideas to many principles of conservation in the home, community, school, state, and nation.

ACTIVITY 4:

Background: The number of micro-organisms found in the soil depends on the type of soil; a rich loam may have as many as 5 billion bacteria per grain. Most of this micro-life exists near the surface where organic matter accumulates.

MATERIALS

- 3 test tubes
- 1 petri dish
- dilution loop
- agar growth medium
- soil sample
- dechlorinated water

Sterilize the petri dish; this can be done in boiling water. Prepare the growth medium (instant media can be purchased from supply houses or recipes for growth media can be found in science sourcebooks) and pour into petri dish. Set this aside to cool.

Sterilize the 3 test tubes and number them 1 - 3.

Fill test tube #1 1/3 full of soil sample and add a few milliliters of sterile dechlorinated water; shake well. Fill remaining tubes with 10 ml. of sterile dechlorinated water.

Using a flame-sterilized loop transfer one loopful of water from the top of soil sample tube to tube #2; swirl the tube to mix. Since one loopful of water is approximately 1/100 ml., the micro-organisms in tube #2 are now diluted to 1/1000.

Flame the loop again and transfer one loopful of water from tube #2 to tube #3. The micro-organisms are now diluted to 1/100,000.

Using a sterile loop, spread several loopfuls of material from tube #3 over the growth medium in the petri dish.

Cover the petri dish and set it aside in a warm place for 48 hours. Observe the numerous colonies of growth; write up your results.

When you are completely through with the colonies, clean thoroughly by flooding the petri dish with a strong bleach.

ACTIVITY 5:

To show students that planting grasses in their own yards will aid the soil to absorb rain and prevent runoff, the following activity can be used.

MATERIALS

- bath sponge
- squeeze bottle
- shallow pan

Hold the sponge in one hand (or have a student hold it) and squeeze the bottle of water onto the sponge. Hold the sponge at an angle so the runoff water can be seen.

Discuss the following questions:

1. Can you see the sponge absorb the water?
2. Can we apply water from the bottle fast enough to cause runoff?
3. Have you ever seen it rain this hard?

   Continue applying water until some begins to drop from the bottom of the sponge. Then squeeze the sponge dry again, refill the bottle with water, place the blotter over the sponge, and repeat the experiment.

4. To what could we compare this sponge? (Soil.)
5. What does the water represent? (Rain.)
6. What happened to the water in the first experiment? (It was absorbed by the sponge.)
7. Was all of the water absorbed? (Almost, very little runoff.)
8. When we placed the blotter over the sponge, what happened to the water? (It ran off; very little was absorbed.)
9. Have you seen soil that responded to rain in this way?
10. What caused the sponge to absorb the water? (Its porous quality.)
11. What things in the soil help it to absorb water more easily? (Grasses, vegetation.)
12. What things cause soil not to absorb rain? (Poor cover, hard clay layers, poor soil structure.)

Ask: How could we help the soil absorb rain more easily? (Plant grasses, etc.)

Have the students take a walk around the schoolyard, or ask them to observe around their own homes. Look for examples of soil that will absorb rain easily, and soil that will not absorb so easily. After the walk, have the students write a composition about their findings. You may want to read some of these in class.

The students might embark on a project of planting grasses or vegetation on soil around their homes to prevent runoff.

ACTIVITY 6:

To help students realize the vital part water plays in the lives of all living things, and their responsibility to protect our water supply, bring to class two containers of water: one containing drinkable water in which you have placed a goldfish, tadpole, or some other creature which survives in water; the other should contain water to which has been added some bleach or other chemical which will kill the fish once he is placed in it (but will not change the appearance of the water).

Ask:

1. What do I have here?
2. From which container of water would you like a drink? Why?
3. Who would like to volunteer to conduct an experiment? After a student volunteers, have him transfer the fish from the first container to the next. As soon as the fish is placed in the water,

it will begin to struggle and die. They may want to take him out, but this will also get across the point.

Questions for discussion:

1. What caused the goldfish to die?
2. Who would like to have a drink of this water?
3. Do we put things in our water which are harmful? How?
4. What happens when the toilet is flushed?
5. What happens to the waste from industry?
6. What happens to the fish in rivers that are polluted by waste?
7. Does this mean our water is not safe for human use?
8. How do we make our water usable? (Putting purifiers in water, etc.)

Have a class discussion on the use of water, contamination of water, and if you desire, the measures taken to make the water usable again. Have the students write compositions on the uses of water, what we do to contaminate it, and how it becomes safe for human consumption.

ACTIVITY 7:

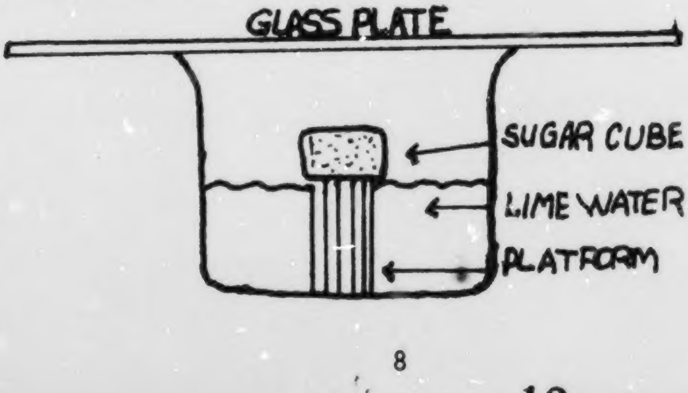
To observe and investigate the necessity of CO_2 for life and to gain an understanding of the importance of CO_2 in our daily lives, have students bubble exhaled air into a beaker containing lime water until it turns to a milky white solution. To this add some elodea and other aquarium plants and place in the sunlight. Note: Within the hour, students should see that the CO_2 is being absorbed by the green plants in the process of photosynthesis:

1. Why did you bubble exhaled air into the beaker?
2. What happened when we added the elodea to the water? Why?
3. What happens when more elodea is placed in the beaker?
4. What happens when a greater concentration of CO_2 is used?

How could we prove that animal life gives off CO_2 while plant life gives off O_2? Have students invent a way that they could prove this point. Teacher acts as a guide by asking questions:

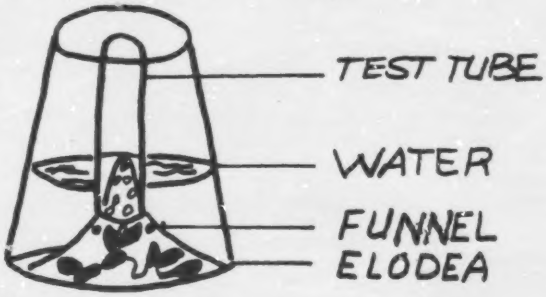
5. What happens if we burn carbohydrates. Rub a lump of sugar with cigarette ashes (to act as catalyst). Place this on some type of platform above the lime water in the beaker. Ignite it and place a glass plate over the beaker.

   a. What happens?
   b. What does this prove?



Formation of O_2 in photosynthesis. (Fix one day ahead of time): Place a few strands of elodea under a funnel in a large cylinder of water to which a pinch of bicarbonate of soda has been added. Invert a water-filled test tube over the funnel, being careful not to allow air to enter the test tube. Leave the jar in bright sunlight for a day. Note: When gas has collected in the tube, place glowing splint into the tube of gas and note the results.

a. What has happened?
b. How could you prove that this is oxygen?



Thus far the students have been concerned with how carbon dioxide and oxygen are formed. Now we want to consider what would be the result of we were to upset the balance of oxygen and carbon dioxide.

1. What would happen if some elodea were placed in a very small closed container of water?
2. What would happen if some elodea and a fish were placed together in a small, closed container of water?
3. What would happen if a fish were placed in a very small container of water? Why?
   a. Why did the elodea die?
   b. Why did the fish die?
   c. Why did the elodea and fish live in the third container?

Draw or paint the planet earth.

a. With no oxygen
b. With no carbon dioxide
c. With no water

Then draw a picture of the earth in which these substances are available.

ACTIVITY 8:

To illustrate how weather information may save life and property, conceal a tape recorder under the demonstration desk. Prepare the tape before class; have all ready to turn on when the class begins. Prepare own tape; it can read something like this: Here is the 4 o'clock advisory from the Miami Weather Bureau. This is the latest report on Hurricane Betty. The hurricane is now located 30 degrees north latitude and 77 degrees 10 minutes west longitude and about three-hundred-fifty miles south of Cape Hatteras, North Carolina. It is moving in a north-northwesterly direction at 10 miles per hour. The hurricane measures about 75 miles across, with winds reaching a velocity of 85 miles per hour.

This is a destructive hurricane. People are warned to go to the mainland and seek shelter. Tides are ranging from ten to fifteen feet above normal on the Jacksonville and Charleston beaches. The storm is due to reach full hurricane force as it comes close to the South Carolina mainland by early Tuesday morning.

Consider how this report may affect a group vacationing at Myrtle Beach.

1. What is necessary for the people to do?
2. Who provides this warning service?
3. What meteorological instruments have been used?
4. Where do the people go in such a storm?
5. What happens to the property?
6. How is the property protected?

This is one type of storm. Other weather disturbances are "watched" by the meteorologist. What are some of these? (Tornado, high winds, thunderstorm, frost, blizzards, etc.)

7. Where are these storms located on the map?
8. What destruction is done to property and life?
9. What precautions should humans take to protect their own lives and their property?
10. How have farmers, for example, made modifications to protect their property from weather conditions?

Place this list on the board:

Agriculture
Architecture
Aviation
Shipping - transportation
Motorist
Public utilities
Housewife
Forester
Business and industry

Discuss how each of these is directly related to the weather. Also relate how life and property is protected in each. (Teacher may want or need to assist in leading the discussion; give these words after the list:)

Agriculture - ponds, windbreaks, frost warning, smudge pots
Architecture - hurricane proof, earthquake proof, color, snow roofs
Aviation - fog, icing, downdrafts, fronts
Shipping - high seas, seasickness, fogs
Motorist - skids, storms, delays
Public utilities - electric lines, floods, warnings
Housewife - recreation plans, food, messages, yard
Forester - fires, cutting, floods
Business and industry - spoilage, sales, looting

11. What can be done to ameliorate or modify the weather?
12. Why is more not done to change the weather?
13. What techniques have been tried?
14. What can and has been done in the conservation of life and property from the weather?

The pupils should investigate the following topics to answer the above questions:

1. Investigate the possibilities of controlling the weather.
2. Try an experiment to seed clouds with dry ice or silver iodide crystals.
3. Investigate major climate changes in past ages.
4. Suggest ways to control fog. What can be done?
5. Investigate the weather satellites and their effectiveness as a weather reporting system.
6. Investigate research projects by the U.S. Weather Bureau.
7. Investigate the possibilities of changing the amount of solar energy received in the atmosphere.
8. Investigate the possibility of discharging an impulse (electrical, nuclear) of some kind in the early formation of an unstable weather condition to prevent the weather condition from becoming a storm, hurricane, hailstorm, etc.
9. Investigate techniques which the meteorologists use to predict certain weather disturbances; what other ways could be developed?

When have changes occurred in the earth's crust from earthquakes and volcanoes:

1. Constructive to life and property?
2. Destructive to life and property?

Is there a warning system?

Read accounts of personal experiences in severe storms or hurricanes.

ACTIVITY 9:

To help pupils investigate the effect of light on green plants, place a radiometer and a green plant on the desk. Hang a light over them. Turn the light on - then off.

1. What happens to the objects on the desk when the light is turned on?
2. What makes the radiometer spin?
3. What effect does the light have on the plant?
4. How does the plant use the energy of the sun?
5. How can you determine whether or not light affects plants?

Pupils will probably suggest that some be placed in a dark box or room. Others might suggest covering a leaf or a part of a leaf to prevent light reaching it. Carry out these suggestions. Test for starch in the leaves not covered, leaves covered, and leaves placed in darkness. Tests follow.

Heat the leaves in hot alcohol until all the green coloring matter is removed. (Be sure to heat the alcohol in a hot water bath. Do not heat alcohol over a flame, as it may ignite.) Place in diluted iodine solution. What effect does light have on photosynthesis? How would plants react to continuous light? Do all plants need the same amount of light for growth? Use a wooden box. (The size and number of potted plants will determine the size of the box.) Paint the inside black. Place a metal tray inside this box on a thin layer of dry sand.

Place one each of the suggested plants in the tray: soybean, salvia, clover, lettuce, coleus, petunia. Use a cardboard box painted black inside to cover the wooden box. Be sure no light can enter this enclosure. The night length period must be total darkness. Fit the box over the plants at the end of the school day; uncover on arrival next morning.

Keep a careful record of the growth of leaves, stems, flowers, and fruit development. One each of the same plants is kept in normal classroom environment. One each is kept in continuous light. Compare growth.

ACTIVITY 10:

To help pupils understand more about one of the forces that trees must compete against to survive - man, take the class on a field trip to several forest areas that show evidence of man's negligence and abuse. Choose areas that show evidence of:

Wasteful and destructive cutting or logging operations, evidence of trees having been cut that should not have been cut, thereby leaving a poor stand and damage to trees that were left.

Uncontrolled or wild fire - 90% are caused by man. (Fire may provide valuable food for wildlife.)

Overgrazing and browsing by animals.

Logging having been carried on during the wrong season of the year, thereby inviting insect attack.

Pupils compare the growth of the trees in the forest. What are the explanations for what they observe?

The teacher acts as a guide to help the pupils find out how man has influenced our forests by asking questions such as: In areas where poor cutting practices have been carried on:

1. What evidence of poor cutting practices are observed here?
2. What effect will this have on future production?
3. What influence will this have on disease and insect damage later? Why?
4. How does this contribute to making the forest more vulnerable to fire?

In areas where fire has burned in recent years:

1. What effect did the fire have on the forest?
2. What evidence do you observe that would indicate that the fire was caused by man, directly or indirectly?
3. What was the purpose for burning?
4. How will it affect future production?

In areas where there is evidence of grazing or browsing by animals:

1. What effect are the animals having on growth of trees?
2. What effect are animals having on seedings and saplings?
3. How good is the grazing?

In areas where logging was carried on during wrong seasons, what effect did this have on infestation by insects and diseases?

During the lesson pupils have been asked to observe how man, through his carelessness and thoughtlessness, has abused one of our natural resources. They now consider what could be done about this. The teacher asks questions such as:

1. What precautions should man take when cutting forest products?
2. What precautions should he take against uncontrolled or wild fire?
3. What can man do to help reduce damage from insects and disease?
4. What precautions should man take against overgrazing?

A field trip is taken to a well-managed forest. Pupils observe the practices being carried out and the results that are evident. Questions are asked:

1. What is the evidence of good cutting practices?
2. What kind of protection do we have against fires? Overgrazing or overbrowsing animals?
3. How does the production here compare with other areas we have observed?

The class considers what action to take to make citizens aware of how their carelessness is affecting our forests, and what can be done to encourage them to be more considerate when working or playing in or near forest areas.

ACTIVITY 11:

Ecology Word Puzzle

There are over 30 words in the block of letters below running horiontally or vertically. Circle or list as many as you can find.

N	O	L	T	I	W	I	L	D	E	R	N	E	S	S	S	G	O	P	G	E
O	N	U	C	D	E	D	R	E	C	Y	C	L	I	N	G	N	P	B	A	O
E	L	H	F	Q	D	L	O	T	O	X	A	S	E	W	A	G	E	I	R	P
A	D	A	P	T	A	T	I	O	N	T	N	F	T	A	B	D	I	O	B	T
I	C	B	H	P	L	A	N	T	S	H	S	N	A	T	U	R	E	T	A	G
R	A	I	J	K	G	M	R	V	U	O	X	Y	G	E	N	S	O	I	G	O
S	R	T	B	U	A	N	P	C	M	F	N	U	P	R	O	D	U	C	E	R
L	B	A	I	O	E	F	L	N	E	C	O	L	O	G	Y	Z	L	N	A	A
A	O	T	U	L	I	T	T	E	R	X	C	O	L	I	F	O	R	M	T	B
N	N	X	C	W	A	S	T	E	T	V	L	I	L	N	C	X	O	N	F	D
D	D	L	U	G	N	O	V	E	R	P	O	P	U	L	A	T	I	O	N	F
F	I	D	M	T	D	C	L	I	N	O	M	E	T	E	R	S	D	I	U	T
I	O	L	P	H	O	S	P	H	A	T	E	S	I	L	S	M	T	S	V	N
L	X	D	A	N	I	M	A	L	S	D	E	C	O	M	P	O	S	E	R	S
L	I	N	S	L	F	O	O	D	C	H	A	I	N	X	N	G	R	O	U	D
J	D	R	S	B	I	O	D	E	G	R	A	D	A	B	L	E	B	O	E	T
S	E	C	O	M	M	U	N	I	T	Y	E	U	A	R	C	D	E	F	X	V

Have students make a pictorial dictionary of ecology terms such as ecosystem, consumer, habitat, predator, prey, biotic, etc. Students can write definitions and add their own drawings or pictures from magazines and newspaper. Students may also make a crossword puzzle using terms.

ACTIVITY 12:

Man has the capacity to make major changes in the environment. To show how dredge and fill induces environmental changes:

Students should prepare a class report on the ecology of an estuary which will illustrate what is being sacrificed in terms of plant and animal life in return for residential and industrial building sites.

Encourage them to illustrate the principle points.

1. What is an estuary? (An area where fresh and salt water mix.)
2. Why is an estuary so important to the development of many organisms? (It is an area rich in food materials and protective hiding places.)
3. How does dredge and fill affect marine life? (Kills it.)
4. What can be done to prevent or limit building in these areas? (Good planning and zoning.)

ACTIVITY 13:

The goals of this activity are to help the student to better understand his environment, the way energy and materials in his environment influence him and are influenced by him, and the role of human ideas and values in the relationship between an individual and his environment.

1. What is the nature of my environment?

Starting with the generalization that a person's environment is "everything that surrounds him", have the student devote a day to identifying as many different examples of the components of their environments as they can. Prepare a list which includes all fo the students' observations. For example:

a. air
b. food
c. people
d. buildings
e. plants
f. animals
g. automobiles
h. heat
i. highway
j. mountains
k. lakes
l. telephone poles
m. laws
n. airplanes
o. clouds
p. rain
q. sounds
r. smells
s. beauty

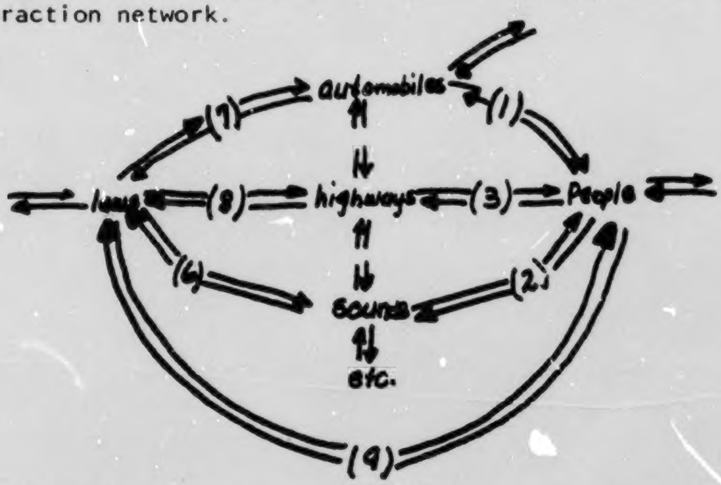
Distinguish which items in the list are living or non-living. Distinguish which items in the list are natural or man-made. Distinguish which items in the list can or cannot be influenced by the actions of people.

Distinguish which items in the list are directly observable with the senses, exist for the individual because they trigger internal feelings (e.g., beauty), or represent human ideas which influence the environment (e.g., laws, architecture). Discuss the questions: "Do two people standing side-by-side exist in the same environment? " Use the answers to develop the idea that human experiences and values play an important role in determining the ways in which they perceive their environment.

Select any single item from the list. Examine it in terms of the ways in which it influences other items in the list and is influenced by other items in the list. For example, if the word "automobiles" is chosen as a starting point:

a. Place the word "automobiles" in the middle of the chalkboard or on a piece of paper. Then place nearby the name of another item from your list which either influences or is influenced by automobiles. Draw arrows between the two words which suggest the manner in which they influence each other. Continue to add words, each time checking for relationships between the added word and all others, in order to develop an environmental interaction network.

For example:



1. Automobiles influence people; as a budgetable expense, in terms of mobility.
   People influence automobiles: in regulating the speed at which they move, in determining the number and kinds which are on the highways.
2. People influence sounds: by using automobile horns, by screeching tires in tight turns.
   Sounds influence people: by producing responses to automobile horns, warning them of danger (e.g., the sound of screeching brakes)
3. People influence highways: by determining where they will be built, by putting limits on them.
   Highways influence people: by influencing where they can live and still commute to work, by occupying land that might be used for other purposes.
4. Automobiles influence highways: by use rates determining when highways should be widened or new highways built, by causing the need for repairs.
   Highways influence automobiles: by determining maximum safe speeds automobiles may travel, by determining routes automobiles must take between two points.

5. Highways influence sounds: in the way the road surface affects tire sounds, in determining the rate at which automobiles may travel and thus wind sounds accompanying rapidly moving automobiles.
   Sounds influence highways: by determining where highways are built (e.g., away from residential areas, hospitals).
6. Sounds influence laws: as a stimulus for the enactment of sound abatement laws, as an influence on the development of zoning criteria.
   Laws influence sounds: by restricting sound-producing activities in the community, by regulating the construction of certain sound-producing devices (e.g., mufflers on automobiles).
7. Automobiles influence laws: by producing a need for traffic regulations, rights of way.
   Laws influence automobiles: by regulating the dimensions, emission properties of exhaust gases, other characteristics.
8. Laws influence highways: by regulating where they may be built, construction characteristics.
   Highways influence laws: by providing a "history" on which highway regulations can be based.
9. Laws influence people : by regulating their use of automobiles, highways.
   People influence laws: in comprising the governmental bodies which make laws, making judgments as to the need for laws.

Find instances in your interaction network where words in the network are not connected directly by arrows to the word "people." By examining the network, determine if these words connect indirectly with "people" by interacting with words which do connect with the word "people." Try to identify as many instances as possible where elements of a person's environment influence him, or are influenced by him, in this indirect manner.

Examine the interaction network in terms of the events indicated below and predict the consequences of these events in terms of the network:

1. completion of the Alaskan Oil pipeline
2. political unrest in the oil-producing countries of the Middle East
3. development of an economical electric automobile
4. diversion of federal funds from highway construction to the development of nationwide mass transit systems

2. How do I affect my environment?

Add to the list of indirect influences compiled in answer to ways in which people directly influence their environments. For example:

a. purchasing food, clothing
b. using heating fuel, gasoline, electricity
c. using water
d. disposing of trash, garbage, and other wastes
e. burning papers, leaves

Examine the combined list of direct and indirect environmental influences and consider the following questions:

a. What accounts for the fact that people often fail to consider many of the consequences of their interactions with the environment? For example:

1. They do not know about some of the consequences.
2. They do not care about some of the consequences.
3. Many of the consequences are felt at some distance from the individual observer and thus cannot be observed directly.
4. Many of the consequences do not occur immediately and thus are remote in time.
5. People establish value-based priorities which may not take into account the environmental impact of their actions.

b. How can students influence better environmental decision-making? For example:

1. by learning more about environmental interactions themselves.
2. by helping to inform their parents, other students, and members of the community
3. by modifying their behavior in ways that lead to better "environmental management"
4. by supporting, through their parents, legislation designed to protect the environment

3. How does my environment affect me?

Survey your total environment and determine those things affecting you which might be classified as:

a. materials - for example:

1. air
2. paper
3. metal
4. plastic
5. various liquids

b. energy (or energy sources) - for example:

1. heat
2. light
3. electricity
4. gasoline
5. heating fuel

c. ideas - for example:

1. beauty
2. ugliness
3. laws
4. conventions

Examine your lists of materials, energy sources, and ideas which comprise your environment and determine those which are essential for survival (i.e., your continued ability to remain alive.) For example:

a. heat
b. food

c. water
d. clothing
e. shelter

a. If the above list identifies the necessities for survival, it might be said that other environmental factors influence the quality of one's life. Consider the following list of activities which are not essential to survival and decide why you choose to participate in them:

1. participation in interscholastic athletics
2. riding the school bus rather than walking to school
3. hiking, boating, riding and other forms of recreation
4. using an air conditioner in your home
5. using an automatic dishwasher in your home
6. flying to a distant community instead of driving an automobile

b. How are your answers to the above related to your life style? can you change your life style? Would you want to?

Choose an activity which is characteristic of your life style, but which is not necessary to your survival, and try to omit it from your daily activities for a week. For example:

1. Walk to school instead of riding the bus.
2. Turn off the water heater in your home.
3. Use no throw-away articles
4. Use no "labor-saving" devices (electric dishwasher, vacuum cleaner).

ACTIVITY 14:

NATURE CITY NEWS

This area has been called Nature's City. In most cities, the day's events are recorded in the daily newspaper. Look around. There's lots of news breaking here today. Do you see a creature stirring. . . an ant, a rabbit, or a bird whose activities you could report on? How does a lichen, a pine, or an ant function as a resident in Nature's City? Could you make up a story about the activities of "Mr. Lichen," "Lady Slipper," or "Peat Moss?" Maybe you want to interview Andy Cove, the stream below. Make up a story about his activities! Use your imagination. Anything goes!

You may also want to include some cartoons or drawings. Remember, the inhabitants of your city are trees, ferns, wildflowers, and old stumps, etc. Each of these inhabitants supports life. Where there's life, there's action. A good reporter reports on the action. In your case, your imagination will supply a lot of the "facts." The following sheets will help you get started. Later, when you return to your school, you will have time to finish up. Your classmates will be eager for the news!

Usually the front page of the newspaper contains the name of the paper, the day's weather, cost of the paper, and the headlines for the major news item. The following fill-ins will help you in getting started.

1. What is the name of your newspaper going to be? ________________

   ____

2. Briefly describe the day's weather. ________________

   ____

3. What is the price of your newspaper? ________________

   What means of currency will forest inhabitants use? ________________

   ____

4. Stroll around slowly. Look for a topic that would make an interesting or exciting feature story. Has your class visit caused a stir? Has anybody new come into the neighborhood? Perhaps there has been a drought, a snow storm, or flood rains? How have these phenomena affected the inhabitants of the city? Choose any topic that you think would make an interesting story and dig in! Use the following space to work on your feature story. Have fun!!

   ____

   ____

   ____

   ____

   ____

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   ____

   ____

5. Now that you have written your feature story, you're an old pro! But reporters are always on the trail of new news. Look around. What makes news in the community? What do you read about in your local newspaper?

   You may want to highlight one individual in the city in terms of their service to the community. Think about how this one individual (e.g., Dandy Lion, White Oak, or Carpenter Ant) makes a distinguished contribution to his or her community. You may need some help determining the role your plant or animal plays in the community. Then you can supply the drama!

   ____

   ____

Do you want to include a picture? If so, who is the photographer? If the photographer or artist were to be a bird, chances are the picture would be taken from a bird's eye view. But an ant would have yet another perspective. Remember to indicate your photographer or artist, for example: "Photo by Blue Jay" or "Photo by Earth Worm."

6. Is there any evidence of pollution in the community? If so, report on it. What has caused it? How might it affect the inhabitants of the city? What is its source? How can it be prevented?

7. You may also want to interview one of the city's inhabitants. Perhaps you could ask them about the impact man has had on their environment. How is man different from the creatures?

8. Have you thought about:
    advertisments?
    a sports section?
    a comic section?
    a classified section?
    birth notices?
    death notices?
    letters to the editor?

Depending on how much time you have available, you may want to include one or more of the above sections. See how much you can make this city come alive in your newspaper. For example, suppose you have a sports section. What events might you report on? Do the toads have jumping contests, woodpeckers - drilling contests, squirrels - nut gathering meets?! If sports is your niche, you'll have a ball with this one!

Chances are, your classmates will be amazed at the news breaking here today. It takes the eagle eye of a good reporter to catch it all!

ACTIVITY 15:

This exercise is designed to help pupils understand the social, economic, and scientific factors involved in the creation and prevention of air pollution.

Before students enter the classroom, light a scented candle. When the class enters the room, let them comment on the room odor. Then ask: What has happened to the air in this room?

On a congested highway what signs of air pollution are evident (Odor of fumes from automobiles exhaust.)

Now let's pretend we are visiting Los Angeles and find the sun's rays dimmed from our view.

1. What factors contribute to the lack of sunshine? (Smoke, dust particles, heavy layers of gas.)
2. What immediate effects would you notice? (Eyes smart, breathing difficult, headaches.)
3. What are the sources of air pollution? (Automobile exhaust, smoke from industry, homes, offices; dust particles, and radioactive waste.)
4. What illnesses are believed caused by air pollutants? (Chronic bronchitis, pulmonary emphysema, bronchial asthma, and probably lung cancer.)
5. How are air pollutants transported? (Weather conditions.)
6. How does nature help with air purification? (Air is cleaned as it filters through vegetation; snow and rain wash pollutants out of the air; some pollution materials fall to the ground.)
7. In many large cities smog causes illnesses and death. What is smog?
8. Why is the problem of radioactive waste going to become more serious? (Because of the difficulty of finding a safe disposal method.)

Ask students to find out if their community has air pollution problems. If so, how are these problems being solved?

9. Why should people who live in towns with no industry be concerned with air pollution?
10. What is being done by the U.S. Weather Bureau to provide warnings of weather conditions that might cause the accumulation of pollutants in the atmosphere? (Started a national air pollution potential forecasting service.)

11. Why is legislation necessary to reduce air pollution?

12. What legislation does your state have?

13. What does the Federal Clean Air Act provide? (For reearch, training, and development of air pollution control; gives money to state, regional and municipal agencies to develop pollution control programs.)

14. Congress passed a law in 1967 on air pollution. How does this law benefit the citizens welfare?

If you live in the area of an atomic energy plant, find out how they dispose of their waste.

As air pollution controls are added to factories, automobile engines, etc., the cost of these products increases.

15. Are we willing to pay more for products in exchange for cleaner air?

16. How can we estimate the price of the loss of health of thousands of people each year?

17. How expensive is the loss of beauty, comfort, or happiness to those who must live in polluted areas?

18. What discomforts and possible illness to human beings occur when crops are dusted and large areas are sprayed with insecticide?

OBJECTIVE:

To describe and order the process of the interdependence of an individual to his biome through the individual's population, community, ecosystem and biome.

ACTIVITY 1:

Background: Physical features such as temperature, altitude, and moisture interacting with soil and water of an area, produce world communities called biomes, each with its characteristic life.

Take students on a field trip to different communities such as a stream, swamp, pasture, and forest. Have them note the differences in various physical limiting factors. In the field students are asked to note the following for each community visited:

Plant life - types
Animal life
Temperature
Soil - nature of
Effects of wind
Exposure
Moisture
Characteristics of total area

The above may be directed to the student's attention through questions or, if time permits, determined experimentally. Other distinguishing characteristics of the area may be considered. The above are but a few possibilities.

Class discussion:

1. How did the plant life differ from one community to another? Why? What factors in the environment determine the growth of the plants noted?
2. Compare the animals found in each community. Why did they choose their respective habitat?
3. Was the forest cooler than the pasture? Why or why not?
4. Which soil contained the most humus? Where was more erosion evident? Why was it most noticeable in that area?
5. How does the availability of water determine plant growth?
6. How do temperature and moisture acting together determine the climate?
7. What effect did the wind have on local areas?

Study maps of the biomes of the world. Try to account for the characteristics of the major biomes . As an outside assignment or class assignment, have individuals or groups choose a biome to study characteristics, plants, animals, climate, and show how these are associated with the biome.

Have reports on results given to the class. Use large map to show biomes as reports are being given. After reports have been given, discuss the following questions:

8. How does the interaction of moisture and temperature help to determine the makeup of a community?
9. What are some of the major world biomes?
10. How does altitude affect biomes?
11. What are the biomes of your local area?
12. What is the significance of a biome? Why should one have an understanding of world communities?
13. What principles of soil, water, forest, and wildlife conservation do you learn from the study of biomes?

Suggested Projects:

Study of local biotic community
Riches in community
Sampling of plant and animal populations of the community

ACTIVITY 2:

Background: All living things are affected by their environment - they are interdependent. Living things (plant and animal) have a direct relationship to each other. Man is included in this, and must, as an intelligent being, do his part in keeping the balance of nature.

Bring to class several pictures (three to six for each student) of trees, plants, birds, small preying animals, snakes, insects, and other living things. Several pictures of people should be included. Give each student a set of pictures and ask him or her to make up a story about the things in the pictures and how they might relate to each other. If your class is mathematically inclined, you might let them make up equations instead of writing stories.

Example: Insects plus snakes equal more flowers.

After the class has written the stories, have several of them read aloud. Questions for discussion:

1. How are animals dependent on each other?
2. How are plants and animals dependent on each other?
3. Why should this concern us?
4. Is it our responsibility to take care of plants and animals? Why?

After the discussion, ask the students to use the same pictures and write another story (or equation), then have them compare the two stories to discover what they have included in the second story that was not in the first.

ACTIVITY 3:

Living organisms are interdependent with each other, as demonstrated by a food web of a given community. To help students understand that all organisms living in a given community are dependent upon each other, take students to a shallow stream or a pond which can be waded. The teacher should make sure that there are no sudden changes in depth or that stream is not contaminated. It is assumed that students have studied food webs, producers, primary consumers, secondary consumers, energy changes and their relationships in a community.

Pupils are divided into teams for collecting aquatic plants, small organisms (by taking samples of water at different depths to get microorganisms), large organisms, and collections from beneath rocks if are present. A thorough cross-sampling of the body of water should be made. Each group should have a secretary to make notes of any organisms seen but not collected. The secretary should make sure his or her team has done a thorough job of sampling.

MATERIALS for collecting

large wide-mouth pickle jars, etc., which have been thoroughly cleaned and rinsed with distilled water

dip nets

Class discussion (following field trip):

1. Why do so many organisms live together?
2. Why do they live in a community?
3. What serves as food for protozoa, fish, insects, salamanders, etc.?
4. From where do the algae derive their source of food and energy?
5. What is the relationship of the amount of O_2 in the water to algae and sunlight? Might undertake project to measure O_2 and show the above relationships.

Laboratory: Each team may identify and relate organisms to others in the web. Each secretary puts the collected information on the board. All students, with the help of the teacher, compile a food web of life in this given body of water.

The above may lead to assignments or discussion of the following:

Complete a food web for organisms found in a pasture community. Make a food web for yourself by listing all the foods you've eaten in the last week. How does a changing community (succession) effect food webs?

What effect do changes in the environment as temperature, drought, moisture, etc., have upon a food web?

Discuss producers, consumers, and decomposers as found in the food web of the pond studied.

Class discussion:

1. What is the importance of a food web?
2. Why can't an individual organism live without other organisms?
3. How does a food web involve the exchange of matter and energy?
4. How are the number of alternate pathways in a food web related to the stability of the community?
5. How do food webs differ from one community to another?

ACTIVITY 4:

The goals of this activity are to help students develop a concept of fields which reflect agricultural, recreational, legal, aesthetic, and other aspects of these features of the landscape. The ways in which fields affect people and are affected by people's activities are explored.

Have students form teams to survey the community to identify fields (e.g., playing fields, parking lots, fields where crops are raised, fields used for grazing livestock, and vacant lots) and determine what a field is by noting the common characteristics of the identified fields.

Have students discuss their findings using the following questions as a guide:

1. Are there topographic similarities?
2. Do fields contain man-made structures?
3. Do all fields exhibit planned uses?
4. Are fields the habitat of plants and animals other than humans? (Detailed answers to these questions may require field investigations including sampling and collecting decisions, and practice in plant and animal identification.)
5. Does the nature and use of fields change through time? (note: Examination of topographic maps and/or aerial photographs taken at different times may help in answering this question.)
6. How do physical factors such as temperature, moisture and prevailing winds influence the character of a field?
7. Are there seasonal variations in the composition of fields?

Have the students plot the locations of the various fields identified on a map and determine:

1. where most of the identified fields are located relative to the central community
2. if there is any relationship between the use of a field and its location in the community

Have students classify the fields according to the following principle uses:

1. agriculture
2. recreation
3. "non-planned-use"

Have students form teams to interview farmers and townspeople to determine:

1. the farmers influence in the local economy through:
    a. selling products for local consumption
    b. selling products to remote markets
    c. purchasing materials and equipment (seed, fertilizer, and farm equipment) from local merchants
    d. employment of local residents on the farms
    e. payment of taxes to the local community
2. the extent farms adjacent to the local community are being viewed as real estate development potential
3. the aesthetic impact of agricultural fields in the countryside surrounding a community
4. the ways privately owned farm land influences highway construction activities
5. the extent farming activities in fields contribute to noise in the community

Have students form teams to interview park directors, school officials, and other townspeople to determine:

1. the number of people in the community benefiting from recreational fields
2. age groups getting the most use from recreational fields
3. how recreational fields are financed
4. the community agencies deciding when and where a new recreational field will be created and how individuals can influence these decisions
5. the cost of vandalism and other misuse of recreational fields to the community
6. the aesthetic effect of recreational fields on people
7. the impact of recreational fields on people
8. the percentage of the population viewing recreational fields in positive terms

Have students investigate ways "non-planned-use" fields influence people by interviewing people who live near such fields to determine:

1. their attitudes toward the vacant lot
2. the extent these fields serve as informal play areas for children who live near them

3. who pays taxes on the fields

Have the students determine the following information about agricultural fields:

1. the steps farmers take to insure continued productivity
2. the extent changes in the markets for agricultural products influence the use of the fields
3. the extent cost of labor, seed, feed, fertilizer and equipment influence use of the fields
4. the extent legislation (e.g., new seed varieties, improved pesticides, and new types of farm equipment) influences use of the fields
5. the extent population growth in nearby communities influences use of the fields

Have the students determine the following information about recreational fields:

1. the community agencies charged with the responsibility of planning, developing, and maintaining recreational fields
2. ways members of the community can influence recreational field development
3. the effects of population growth on recreational field facilities
4. the difficulty in hiring personnel to staff the recreational fields
5. the extent vandalism has increased the maintenance cost and curtailed use of the recreational fields

Have the students determine the following about fields with "non-planned-use":

1. lack of interest in developing the fields for recreation or housing
2. the classification of these fields according to community zoning codes
3. the plans for future development of these fields

Have the students use their maps to plot the location of various fields, to determine:

1. the relationship between the location of a field and the price of land in the area
2. the fields considered most likely for real estate development in the near future and why
3. the relationship between field location and the zoning classifications of the area

Have the students form positive and negative teams to debate the issues revealed by the following questions:

1. To what extent should the use of a field be the decision of:
    a. the person who owns the property
    b. the residents of the community in which the property is located
2. Should land zoning decisions be based on the concerns of:
    a. the people who live immediately adjacent to the area in question
    b. the person who owns the land
    c. a community agency
    d. a vote by the entire community
3. Which is the most important use of fields:
    a. a place where plants and wildlife may flourish undisturbed by people
    b. a place where recreational needs may be satisfied
    c. a place which, by its naturalness, will enhance the aesthetic qualities of the environment
    d. a place where needed agricultural products may be produced
    e. a place where man-made structures should be built to benefit masses of people

ACTIVITY 5:

Background: Most communities of plants and animals tend to change. A group of organisms is replaced by a second, the second may be replaced by a third. Each new organism that gains supremacy alters the environment and provides conditions that favor other species. Thus, populations may change from hour to hour and day to day. Some successions, such as changing organisms in a temporary rain puddle, occur on a very small scale. Such a succession is usually over in a matter of days. Other successions, such as a change from bare ground to mature forest, may take a century or more.

MATERIALS

5 jars to collect pond water
cultures of pond water
centigrade thermometer
Hydrion paper
microscope
cover glass
light meter
pipette
slide

Procedure: Select a stream, pond, or lake from which you can collect your water cultures. Fill five quart jars three-fourths full of water containing some plant material. Some cultures should contain floating vegetation such as duckweed, others should contain algae only, and one culture should contain some submerged vegetation and dead plant material. This will create a different environment for each culture.

Place the cultures in an area of the laboratory where each will receive the same amount of light. If you have a light meter, check the light at various times of the day.

1. What is the variation in foot candles of light available to the cultures?

2. Why is light important in the study?

Using a centigrade thermometer, check the temperature of the culture each day that you examine the water.

3. Why is the temperature an important factor in succession in the jar?

Using Hydrion paper, check the pH of the medium each day of the examination and draw a line graph of the changes.

4. How is the pH of the medium related to succession?

5. What factor is responsible for the change in pH?

Examination of the cultures should be made on alternate days for a period of three weeks. Since organisms occur at all levels of the culture, remove a drop from the surface, a drop from approximately 4 cm from the surface and one from the bottom for study. Study each drop of water under the low power of the microscope and determine what organisms are present.

In the five drops taken from the surface, count the number of each species present. Determine the average number of each species in the five drops.

Set up a chart on which to record these averages. The chart should include such groups as green protists, non-green protists, rotifers, crustaceans, annelids, gastrotrichs and others, as you find them.

6. What type of organisms did you find on the first day of examination?
7. How long did these remain the dominant organisms?
8. Describe any changes that occur in the water.
9. What caused the changes in the water?
10. What organisms assumed dominance after the water became turbid?
11. Explain why these organisms became dominant.
12. Explain why the cultures became clear at the end of the experiment.
13. What organisms followed Colpoda and Colpodium in the succession?
14. What other organisms occurred in the succession?
15. When did the rotifers and gastrotrichs appear?
16. What factors govern the succession in the water cultures?

ACTIVITY 6:

To help students understand the value of predatory animals to a balanced community, take students on a field trip to a wildlife preserve, refuge, or sanctuary. Previous to the field trip, discuss the balance of nature, predator-prey relationships, and food webs. On this field trip they are to conduct samplings of the population to establish the predator-prey relationship in a given area.

In the type of forest area recommended, set up experiments for sampling the animal population. (Various groups may take different groups of animals.) Secure the following information for each animal.

1. Name of animal
2. Number of individuals
    a. males
    b. females
3. Feeding habits
    a. food
    b. how secured
    c. time of day feeding is accomplished
4. Habitat
5. Means of defense
6. Natural enemies
7. Are there any special management practices needed to maintain their number or keep them from increasing too rapidly?
8. How does it contribute to the balance of life in the community?
9. Relative number in area?
10. Does area show balance?
11. What are the predators?
12. What serves as prey?

Consult local game warden for:
    local game laws
    animals that he knows are to be found in area

Consult local citizens who are familiar with area and have them give you names of animals found there.
Discuss:
1. How the balance of nature was shown in area studied (if it was).
2. Predator-prey relationships of area.
    a. develop food web to show these relationships
    b. How are the organisms beneficial to man, nature, soil, water and wildlife?
3. Game laws of area, hunting season, and the reasons for them.
4. What are wildlife refuges, preserves, and sanctuaries?
5. How is a balance maintained in a preserve?
6. Local fishing laws. Is it better to fish or not to fish in a pond? Why?
7. How is a balance maintained in the bird population?

8. Various methods of keeping animal populations in a balance with available food supply.

9. How is overpopulation of a community harmful to the species?

Investigate:

1. What are some animals which have become extinct due to man's malicious killing?
2. How are predators related to a balance in nature?
3. Is a true balance in nature ever reached? Why or why not?
4. How are game laws and hunting seasons of importance?
5. Why are "bag limits" rather than "no hunting" practiced?
6. Why are wildlife refuges, preserves, and sanctuaries important?

A wide variety of projects and hobbies may evolve from the study of this concept. A few suggestions are:

Furnish nesting and feeding places for birds
Cooperate with U.S. Fish and Wildlife Service in bird banding
Develop wildlife refuges for conservation study
Organize bird clubs and walks
Become familiar with and practice game laws

ACTIVITY 7:

To provide pupils with an awareness of the valuable resources available in the ocean, display three containers of water:

Water in which salts (chemicals) have been dissolved
Tap water
Distilled water

Do these solutions look alike? How can we test to see if the solutions are the same? Evaporate the solutions. Observe the solids lift after evaporation. (Have condenser set up for the distillation of the water.)

Discuss methods for the extraction of minerals from the water.

1. Why should man turn to the ocean for minerals?
2. How did minerals get into the ocean? How do they get back to the land?
3. What minerals are found in solution in sea water?
4. What minerals are found in the sea's floor?
5. How are these minerals used?
6. What is their economic value?

Is sea water being used as a source of fresh water? How does our simple experiment show a way of obtaining fresh water from the sea? What are the possibilities of farming the sea? What crops would you find growing? What might you plant?

How will it be possible to harness the energy of the ocean? Of what value is the ocean's floor in preserving and revealing the earth's past history?

Investigate methods for identifying the minerals of the sea. (Flame tests, blowpipe tests, chemical tests for nitrate, phosphate, sulfate, etc.)

Have the pupils find methods of obtaining fresh water from sea water. Construct a model solar still.

Make a list and report on minerals now being mined from the sea. (Sulfur, bromine, etc.)

Draw and illustrate the phosphorus cycle, from fertilizer used in the soil, to the sea, back to the soil.

ACTIVITY 8:

Students shall investigate the problems of expanding animal and human population.

Have a student draw on the classroom floor, in a corner if possible, a four-foot-square area. Then ask the students to stand in this area.

Ask this question: How well could you perform all your daily activities in this amount of space?

Follow with these questions:

1. What are your daily activities? (Students will probably suggest sleeping, eating, personal health and body functions, recreation, studying, working, etc.)
2. How much space do you have for performing these activities?
3. What would happen if you only had one square foot of space in which to do all these things?
4. What conditions would allow you only this amount of space?
5. When is this condition likely to occur?
6. Why will this involve not only man, but other animals also?
7. What would happen to plant life if the earth becomes this crowded?
8. What would happen to our food supply?
9. How could man and animals survive without land on which to grow food?
10. How does nature limit population in lower animals?
11. Why would a classroom of 20 students have a better learning atmosphere than a classroom of 60 students?

Have students investigate the following and report to the class:

Find the population of the local county, state, nation, and world.
Find the average number of children per family in the classroom.

Find the current number of births and deaths per year in the local county, and those of 25 years ago, if possible.

Have several students choose one animal each (bird, fish, rabbit, snake, oppossum, horse, elephant, whale, rat, ostrich, etc.) and find out the number of young produced each year; the number that reach maturity; the reasons why all do not survive.

Find reasons for decrease in mortality rate.

ACTIVITY 9:

To help students appreciate the value of the preservation of wilderness areas - value to the individual, to science, and to their cultural heritage, take a field trip to investigate loss of wilderness areas - wooded areas that are giving way to something else (logging, manufacturing, used car lots, etc.)

Have you been here before?
How do you feel as you see this happen?

Discuss:

1. How has the loss of wilderness affected wildlife?
2. How has it affected particular animals? (mountain goat, whooping crane, bear, deer?)
3. What other effects have you observed?
4. What changes have you noticed in other trips you have made?
5. Talk with your parents about loss of wooded areas they may have observed.

Investigations:

1. Investigate to find out the extent of wilderness areas in 1960, 1700, 1800, 1900, and compare with today.
2. Find out the number of acres of land that have been covered by highways in your state. Do you think they need to go everywhere? Why, Why not?
3. Read and find out what the following people have contributed to conservation of wilderness: Gifford Pinchot, John Muir, John Marshall, Howard Zahnizer, Justice William O. Douglas.
4. Report on book Walden by Thoreau.
5. Investigate controversies over additions to our national wilderness system.

Have students write for information on this subject. Suggested sources are:

Wilderness Society, Washington, D.C.
The Sierra Club, San Francisco, Calif.
U.S. Forest Service
National Park Service

Investigate what is being done now - new things that are happening (controversy over Grand Canyon, redwood trees, the North Cascades, roads in the national parks).

Discuss:

1. How can too many visitors contribute to destruction of the wilderness? How can you contribute?
2. How are wilderness areas in remote sites important to you, even though you may never visit these areas?

ACTIVITY 10:

To compare the abundance and variations of animal and plant life taken from natural, undisturbed habitats with those found in dredged, flooded, or polluted areas, display pictures showing inlets, estuaries, and marshlands undisturbed by man. Also display pictures of draglines cutting into these areas, dredging creeks, filling in areas to build lots, etc. Place an empty tank on the desk.

Why are wetlands being destroyed?
What reasons can you give for protecting them?
What reasons can you give for destroying them?

Prepare the tank for salt-water organisms. Using liquid aquarium cement, allow the pupils to paint all metal surfaces which will be exposed to salt water. The undergravel filters are placed, and an outside filter is connected. The tank is then filled with ocean water, brought from the ocean in clean plastic containers. Filtering is begun.

Take the class to the seashore. To have an effective field trip to the tide pools, the class should be divided into several groups according to their interest. Each group will bring back to the class a detailed report. Pupils should dress appropriately for the trip. Take a seine and plastic buckets. Check the tide table for the time of low tide. Pull the seine, dragging the bottom of the inlet lightly. Collect organisms, and carefully drop them into the containers. On return to school, put the organisms into the tank immediately. Using books with good illustrations, the pupils will list their catch. Use the microscope for plankton. Group the organisms, depending on their value to man. They would be listed under FOOD, SPORT, COMMERCIAL (for example, menhaden is used for many things), SCIENTIFIC RESEARCH, ETC. This list reveals to the pupil the abundant life in the sea and its tremendous importance to man.

Take the pupils to an area where dredging is being done or where the water is polluted with garbage, refuse, or junk. Use the seine again and compare this "catch" with the first. Has man made a difference?

Have pupils write an article for publication using as the subject, What Wetlands Mean to Us Today. Have pupils list ways they can help to preserve life in the wetlands. Example: Avoid polluting waters with refuge, garbage, or junk. Is man justified in destroying wetlands.

ACTIVITY 11:

To give the pupils an understanding of the forest biome and to develop an appreciation of how this great renewable resource contributes to our lives, display the following objects on the desk. Pick each up and ask the class to identify them.

A book
A roll of film
Imitation leather belt
Lump of sugar
Bottle of molasses
Cellophane
Piece of felt
Block of wood
A rayon scarf
Can of lacquer
Bottle of alcohol
A plastic dish
Wooden spoon
A block of pressed board

Ask:

1. How many of these objects have you used?
2. What do they have in common?
3. What were they made from? (Students will readily recognize that some of the objects were made from wood, and will probably guess that this is what they have in common.)
4. Why do some of the objects not look like wood?
5. What has happened to change the wood?
6. What is the main part of wood like? (Here the teacher can pound a twig of wood until it is pulverized and allow the students to examine it.)

Have the students make a list of other objects that are made of, or from wood.

1. What are these objects used for?
2. Why were they developed?
3. What other substances could these objects be made from?
4. Why should we treat the forest with great care?

If a forester is available in the community, invite him to accompany the class on a field trip. The class members should be allowed to identify and point out the kinds of trees they see on the trip. Have them tell how the different kinds of trees are used. Some of the students can make a collection of leaves that they can mount in a scrapbook. (As the leaves are collected, place them between the pages of magazine to keep them flat. They can be waxed by pressing them between sheets of waxed paper with a warm iron.) Later pupils can mount them, classify them, tell use, where grown, and other interesting facts.

Have the students observe such things as:

1. What methods of forest management are being used?

2. What evidences do the pupils see that better management is needed?

3. What evidences can be seen that the forest is being wasted or destroyed? (The students will probably see such evidences as forest fires, diseased trees, insects on trees, overcrowded or overgrazed areas.)

4. What are the factors which can destroy the forests of keep them from being productive?

Assign the following reports:

Why the Forests Are Necessary to Us
Rules to Remember About Camping in the Forest
What Burning of a Forest Can Mean to Soil, Water, and Wildlife
Weed Trees
Forest Fire Laws in Local Community
Methods of Tree Harvesting
Types of Trees that Are Best for Wildlife
Diseases that Attack and Destroy Trees
Overpopulation of Wildlife Can Damage Forests
Insects Detrimental to Forests
Other Possible Uses of Wood

ACTIVITY 12:

To help pupils appreciate the struggle of competition between organisms in the environment, perform the following experiment.

Some time (2 weeks) before the lesson is to be presented, have a group of students plant about 20 bean seeds in a milk carton of garden soil. In a second carton, containing the same kind of soil, plant 5 seeds. They should be placed where they will receive an adequate amount of sunlight and should be watered frequently. During the time the plants are in the classroom, students can be observing, but if questions begin, do not answer them. Simply tell the students to continue observing. (Turn plants daily.) On the day the lesson is to begin, place the plants on the desk. Ask:

1. What have you observed as the plants grew?
2. What differences can be seen between the two cartons?
3. What substances or energies have the plants used?
4. What conclusions have you reached at this time?
5. Which plants appear to be the strongest? Why?
6. How can this investigation be compared with a crop?

Take the class into the forest. (Have these assignments made before the trip.)

a. Have some students measure the distance between trees which are about 8 inches in diameter.

b. Have another group measure trees about 12 inches in diameter.

c. Have a group look for smaller trees or shrubs and note the distance between.

d. Have another group observe the small plants and flowers to see where they are growing.

e. Another group can observe plants growing in the humus layer.

f. Have another group look for plants growing in the fields or in the schoolyard that are growing very close together, forming carpet.

The following day ask:

1. What plant life grows the greatest distance apart?
2. Which plant receives the most sunlight?
3. Which plant receives the least amount of sunlight?
4. Which plant uses the most water?
5. Which plant uses the least amount of water?
6. How is it possible that in a given area of about 50 square feet all these kinds and sizes of plants can be found?
7. Could many trees of a 12-inch diameter grow in a 50 square-foot area? Why or why not?
8. Which plants were found in the top layer of strata of the forest?
9. Were other plants found in other layers?
10. How are food crops spaced in the field?
11. Why are some crops, such as grain or grass, planted very close together?
12. What would happen if beans or corn were planted as close together as grass?
13. Why is it necessary that some food crops were planted as close together as grass?
14. Why do some plants die in overcrowded areas?
15. Which plants usually survive?
16. How does a plant compete for survival?

Have students look for ways in which plants have become adapted to the environment. Show film about planting and plant management. If film is not available, pictures can be used successfully.

Have students make some comparisons between plant and animal competition.

ACTIVITY 13:

To help pupils understand the interdependence of living things by observation and investigation, take a field trip and ask students to make a list of the wildlife found in the community. The teacher needs to remember that on a field trip few animals might be seen; therefore, class must be on the lookout for evidence of wildlife such as bits of fur, hair, or feathers, places where they have eaten, tracks, nests, burrows, , etc.

Pupils are asked to bring the list that has been made of community wildlife. Ask them to name and classify these animals.

1. What are the animals listed?
2. Were they all found in the same place?
3. Or did they have different environments?

Have pupils compare their list with the state listing of wildlife which can be secured from the state conservation agency.

Did the pupils find all the animals listed for their state? If not, why not?

Which animals are not native to the region? Has the introduction of new animals been successful, or has it developed more problems than the original problem? Example: The starling was brought over from the British Isles to help destroy certain insect pests. They have become destructive to native birds.

During the days the lesson is in progress, ask pupils to observe one particular animal (bee, squirrel, frog, or bird, etc.) as closely as possible. They will need to keep a record of habitats, needs, habits, benefit to man, or any other interesting facts, and report to the class. Students can obtain information concerning wildlife conservation practices in their community, and discuss ways they can help.

1. What is the community doing to help provide habitats for wildlife which are commonly scarce?
2. What is the state doing?
3. Does the community environment provide adequate food for the plant-eating animals (herbivores) and the flesh-eating animals (carnivores)?
4. Is the water supply adequate?

Invite a resource expert such as a game warden to visit the class to explain how laws and regulations are enforced to help protect wildlife. If time permits, a second field trip can be taken. Compare lists of wildlife with first field trip.

ACTIVITY 14:

To help pupils understand the interdependence of living things by observation and investigation of the part plants play in the balance of the environmental structure, take a field trip, since this is the best way to study plants in their environment. Pupils can make a list of plants found in the community. (Teacher should be fully aware of local and state laws and regulations concerning the picking of wild plants.)

Have the pupils list and classify as many wild plants as possible that are found in the community.

1. What are the names of the plants?
2. How does the pupil's list compare with the state listing?
3. Were all of the plants found? Why not?
4. Which plants are most abundant?
5. Which are least abundant? Why?
6. What benefit are plants in helping maintain the balance in the community?
7. How are plants and plant products used?
8. Which plants are native?
9. Which have been introduced and why?
10. What problems have arisen from the introduction of the new plants?

As the lesson progresses, the pupils are asked to study a particular plant in the field and do research as to its origin, use, particular structure, fruit, flower, etc. and report to class.

> Are the needs of wild plants in their environment different from that of cultivated plants?
>
> Which plants provide food for human and animal needs?

Show a film relating to plant conservation. Ask pupils to find out how plant life has been destroyed in the community. What have been the results?

Discuss pros and cons with your class of making a wildflower collection. Keep in mind state and local laws.

> Are these laws justified?
> Should they be changed in any way?
> Is the taking of plants justified for scientific study?

ACTIVITY 15:

Maintaining living plants and animals in the classroom is an excellent way to show interdependencies.

MATERIALS

Any materials - usually scrounged - that can be used for plant/animal environments:
- Aquarium
- Screen wire
- Strip lights
- Pet cages

Many teachers already maintain plants and animals in their classrooms. Students like to be asked to bring from home plants and animals that they would enjoy culturing in the classroom. It is easy to start a

43-A

discussion about why they want to keep these living things at hand; why they think (or do not think) it is a good idea to have them in school. Once acquired (and such activities have a way of snowballing) the living things may be observed, housed in habitats constructed especially for them...designed and redesigned as needed; organisms may be kept together to see if they can adapt to the same environment and to each other; effects of temperature, shade, light dark may be measured. It is possible to inventory the needs of the organisms on a day-to-day basis and perhaps plan for a week-end with no one in attendance, and then a more extended holiday.

It is interesting to look for organisms which normally inhabit the classroom on a permanent or transient basis. Questions can be raised as to what reasons cause the organisms to come to the classroom, what sort of shelter they find, on what they may feed, etc. Students may be led to question how the classroom is changing...on a daily basis and a seasonal basis, with respect to temperature cycles, light cycles, noise cycles, etc. The interdependence of animals, insects, man, and the physical environment can be explored.

These openers should lead to the discussion of animals in the area and should encourage students to study and record wildlife around the school. Before actually collecting animals, have the students investigate and inventory the basic needs of the organisms they are considering for the class. Have them think about water supply, heat, light, food and temperature factors as well as where in the classroom they will house their menagerie.

After deciding on the first organisms to collect, have students construct the habitats (if possible, have them observe the animal in its natural setting and simulate it as much as possible).

Start small! Have each group or groups maintain only a few animals at first until they get the feel of the job. Have them keep a log or chart on the bulletin board to display data they collect.

After successfully maintaining their organisms they may want to combine several organisms together which have the same basic needs.

Have the plant enthusiasts try and set up a greenhouse, or become classroom farmers and raise the foods preferred by the animals in the classroom.

See the chart on the following page for a suggested sequencing of activities.

Have students prepare slides, filmstrips, or films to show their activities during this unit. (Note: It is suggested that this unit be a long-range project, perhaps lasting the entire school year.)

Should a teacher wish to experiment with a "population explosion" in class, it is easy to simulate one using inanimate objects, such as chairs or stools. Place one at the back of the room on Day 1; two on Day 2; four on Day 3, eight on Day 4; 16 on Day 5; etc. A vivid, if disruptive, demonstration of the exponential growth of population will impress all classroom members.

Flow Chart

Ecosystems

Preliminary Activities:

ESS Units
- Pond Water
- Tracks
- Animal Activity

Field Trips
- Zoo
- Aquarium
- Museum

Main Activities: Class Discussion: Do we want to keep animals and plants around school? Why? What must we do to keep or study animals or plants?

Make the most natural possible habitat for an animal or plant

Learn all we can about our classroom pet

Choose animal or plant

Find out about local plant and animal populations

Study natural environment, research species

Choose an area to study

Design and build container

Build container to combine several animals and/or plants

Observe and experiment to find out its behavior, likes, dislikes, etc.

Catch/collect animal(s) and/or plant(s)

Keep records

Class Discussion: Review and analyze observations and data

Keep in Habitat
Observe
Keep Records

Class Discussion: Analyze observations and experiments

Modify care, container number of animals, etc.

Class Discussion: Analyze Records

Write up report, publish booklet, make slide show or film, etc. to show other students or groups what they have learned.

ACTIVITY 16:

The number of plants and animals of a given species that can live together in balance in a community is limited. To illustrate this concept, take students on a field trip to an area where a community can be studied. They should investigate area and complete the following:

1. What is population?
2. Make a list of as many of the plant and animal populations of the area being studied as possible.
3. Discuss the relationships of these organisms to each other (food web).
4. What biotic factors limit the life of this community?
    a. Name predators observed.
    b. What serves as the prey?
5. List biotic factors observed in area. From the list of organisms, complete population counts for dominant species of plants and animals. (Note: This will require another day for preparation, consult: Phillips, Edwin A. Field Ecology, BSCS)

To study the species and environmental factors of the population, investigate the species factor. (Number of offspring, care of young, age of maturity, frequency of reproduction, duration of reproductive life, etc.)

Compare the number of offspring to parental care. How do animals help keep their population in balance? Investigate the environmental factors. (Weather, food, cover, hunters, disease, etc.) How do these two factors interact?

Take an animal you know (deer, quail, grouse) and discuss its species and environmental factors, and how they interact to determine the population in a community.

Class: Calculate relative frequency, relative density, and relative dominance of the species populations counted. Show how mortality, natality, immigration, and emigration rates affect population densities. Justify the following statements:

As the environment changes, populations change.
In natural communities, populations are continually changing.

Discuss the upper and lower biotic and abiotic factors of community.

Discuss the following:

Survival of the fittest
Balance of nature
Natural selection
Selection by man

Questions:

1. Why have some animals become extinct?
2. What is meant by upper and lower limits of a population?

Encourage projects such as:

1. Measurement of populations of different communities.
2. Study of balance of nature in a given area.
3. The importance of soil, water, and wildlife to a community.
4. Study of various determining factors of a population as natality, mortality, age, distribution, biotic potential, dispersion, and growth.

ACTIVITY 17:

To provide experience in problem solving concerning the environment, use the following value sheet.

VALUE SHEET: MARSH MOCCASINS

"Snakes! Snakes!" cried Joan Bradley, rushing to the hospital attendant. "My little Jennie has been bitten by a snake!" Moments later another child was carried in for a snake bite. After a brief discussion it was discovered that both children were bitten by water moccasins while playing near a marsh area on the outskirts of the city. Two weeks later, a junior high student was also bitten by a marsh moccasin.

The city council met and decided that a dangerous situation existed. After a long discussion, members of the council listed eight possible actions. Below you will find the choices. Consider each of the alternatives, and rank them according to the most desirable choice to the least desirable choice. You must rank each alternative.

ALTERNATIVES

__________ Construct a fence around the marsh area so that children can be kept from the snakes.

__________ Scatter poison thoughout the marsh. This will kill the snakes, but we will still have our marshlands.

__________ Use bulldozers to fill in the marsh; city council will then build a playground park.

__________ Local school officials will develop and implement a program which includes instruction in the area of necessity snakes in the food chain, discussion and exploration of snakes' habits and habitats, and discussion of how to avoid potential dangers.

__________ Conduct a snake round-up and transport poisonous snakes to nearest reptile institute.

________Pour oil on the marsh and set fire to the area. After doing this, re-seed with low-growing grass.

________Import hawks into the area - a natural enemy to snakes.

________Drain the swamp; dig out canals for boat passage; construct boardwalks.

DISCUSSION QUESTIONS

1. What was the council's responsibility?________________________

____

____

2. Are snakes important members of the food chain?________________

Why?____

____

____

____

3. What choices in the example above were temporary solutions?

____

____

Permanent solutions:____

____

4. What choice in the example above was most damaging to the marsh ecosystem?____

______________________________ Why?______________________________

____

5. How does addition or elimination of a member of the food chain affect marsh life?

____

____

____

OBJECTIVE:

To construct the major ecological cycles and their cause and effect relationships with the biotic world.

The major ecological cycles are as follows:

1) water cycle
2) nitrogen cycle
3) carbon-oxygen cycle
4) energy flow cycle

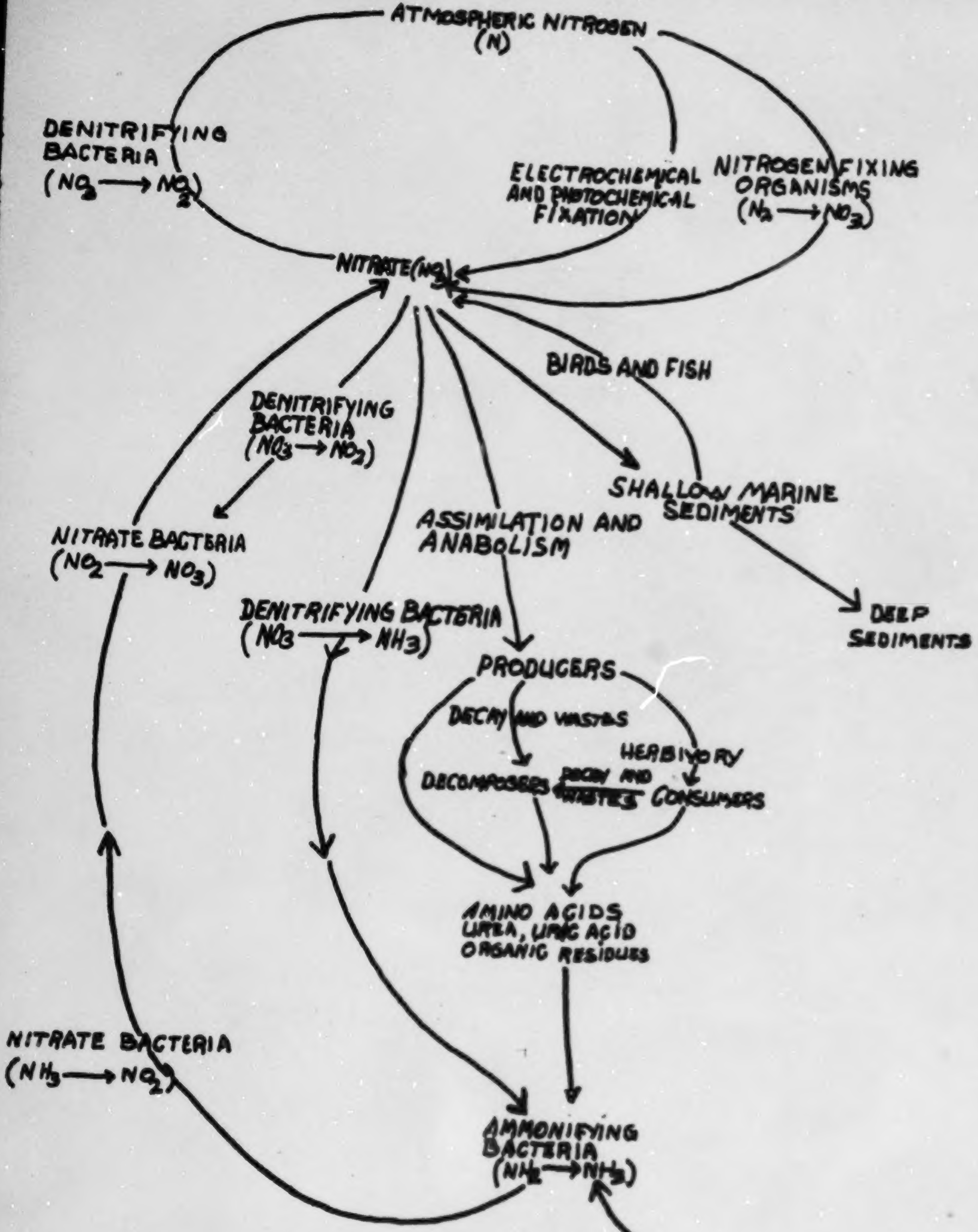
These cycles can be located in the following sources.

WATER CYCLE - Modern Biology, 73 Holt, Rinehart and Winston
749-751.
BSCS Green Version, 2nd Ed. Rand McNally, pg. 24.

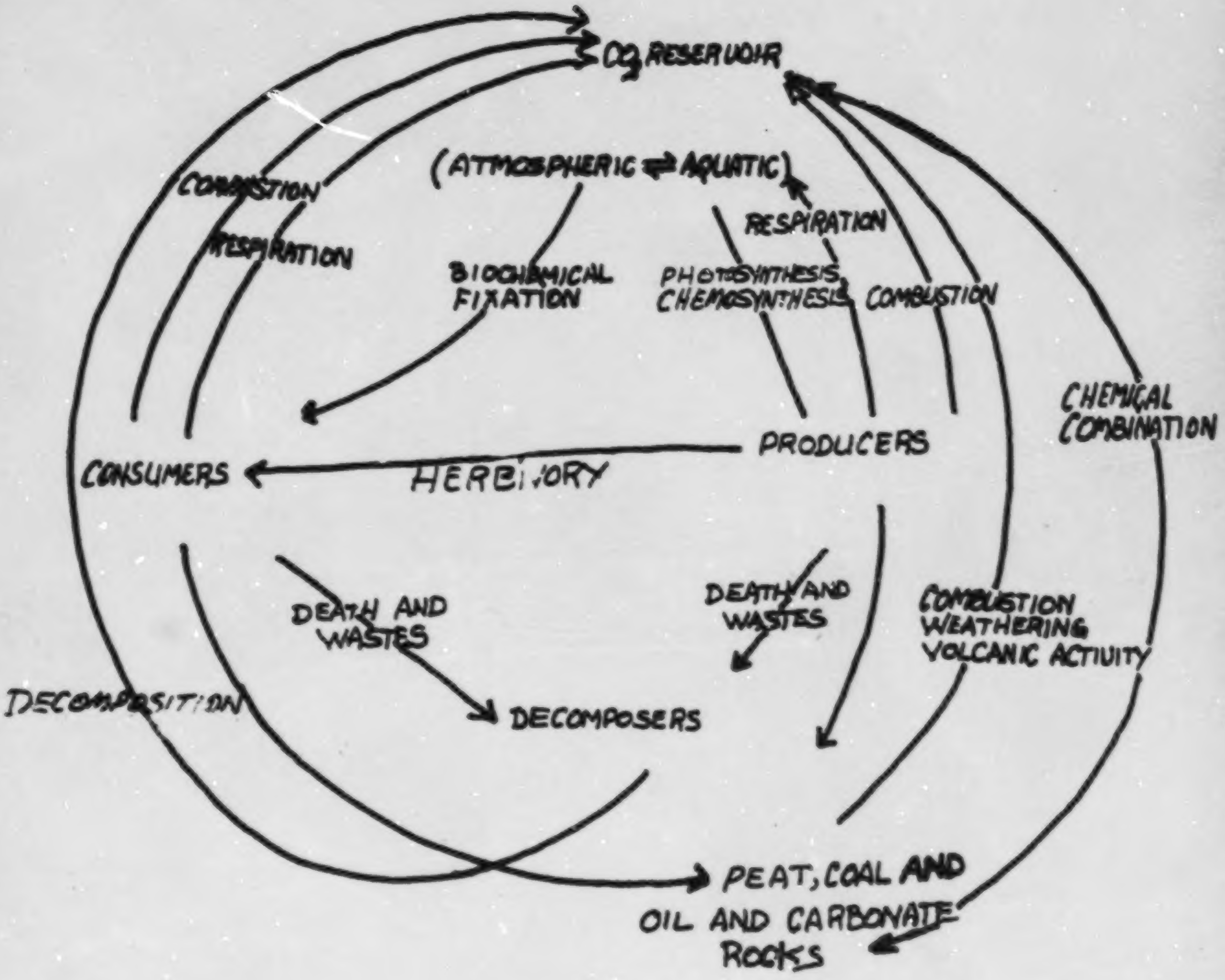
NITROGEN - Modern Biology C 73, Holt Rinehart and Winston
pp 752-754
BSCS Green Version, 2nd Ed. Rand McNally
pp 243-245
Biology, Silver Burdett Smallwood, Green pp 327-329
& 332
Also See Figure 1

CARBON-OXYGEN CYCLE - Modern Biology C 73 Holt, Rinehart and
Winston pp 751 - 752
BSCS Green Version 2nd Edition, Rand McNally
pp 23-34 & 26-28
Biology - Silver Burdett, Smallwood, Green p. 326
Also See Figure 2

ENERGY FLOW CYCLE - See Figures 3 and 4.


ATMOSPHERIC NITROGEN (N)
DENITRIFYING BACTERIA ($NO_3 \longrightarrow NO_2$)
ELECTROCHEMICAL AND PHOTOCHEMICAL FIXATION
NITROGEN FIXING ORGANISMS ($N_2 \longrightarrow NO_3$)
NITRATE (NO_3)
BIRDS AND FISH
DENITRIFYING BACTERIA ($NO_3 \longrightarrow NO_2$)
SHALLOW MARINE SEDIMENTS
NITRATE BACTERIA ($NO_2 \longrightarrow NO_3$)
ASSIMILATION AND ANABOLISM
DEEP SEDIMENTS
DENITRIFYING BACTERIA ($NO_3 \longrightarrow NH_3$)
PRODUCERS
DECAY AND WASTES
HERBIVORY
DECOMPOSERS
DECAY AND WASTES
CONSUMERS
AMINO ACIDS UREA, URIC ACID ORGANIC RESIDUES
NITRATE BACTERIA ($NH_3 \longrightarrow NO_2$)
AMMONIFYING BACTERIA ($NH_2 \longrightarrow NH_3$)
VOLCANIC ACTION

THE NITROGEN CYCLE
FIGURE 1



THE CARBON CYCLE

FIGURE 2

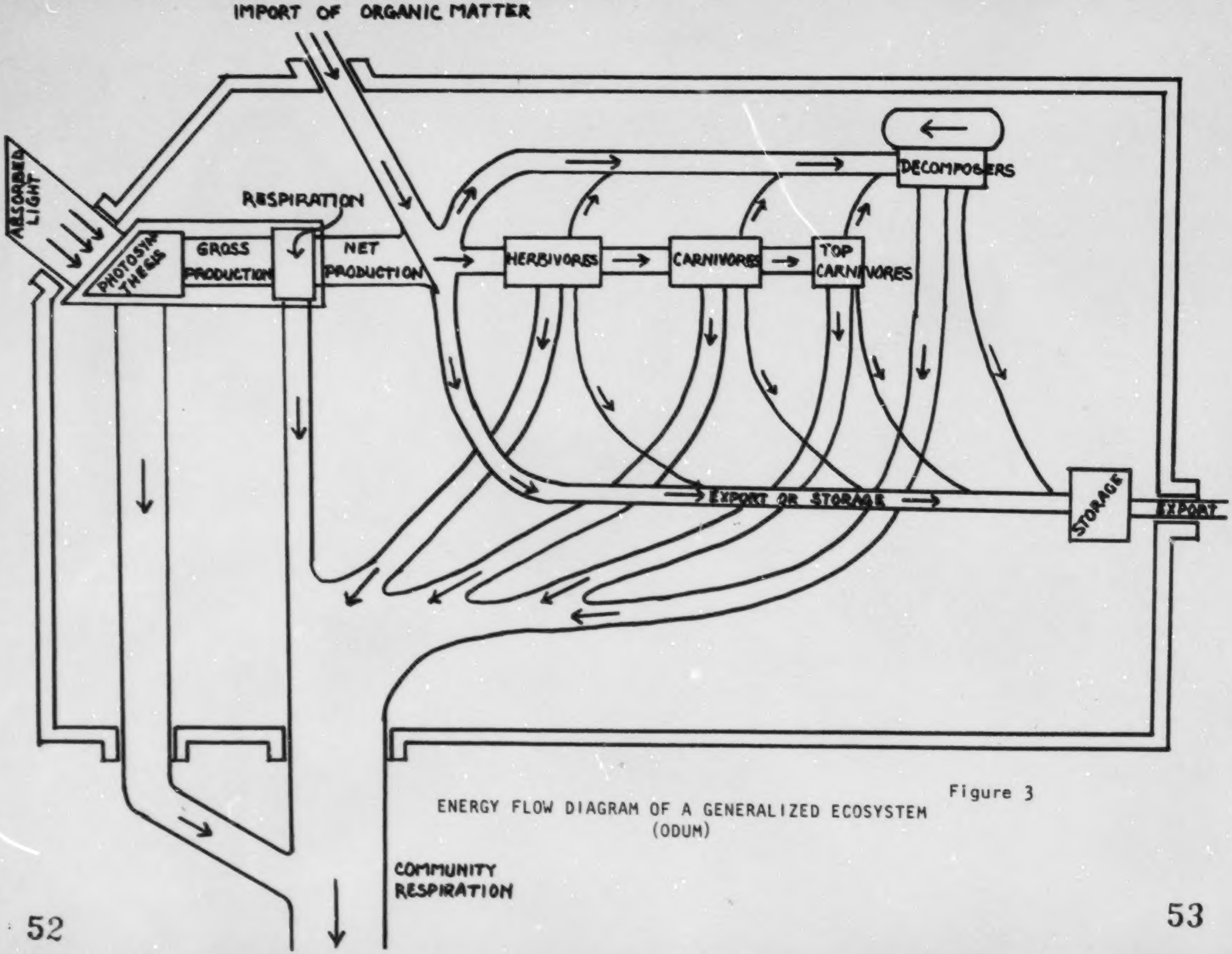


Figure 3

ENERGY FLOW DIAGRAM OF A GENERALIZED ECOSYSTEM
(ODUM)

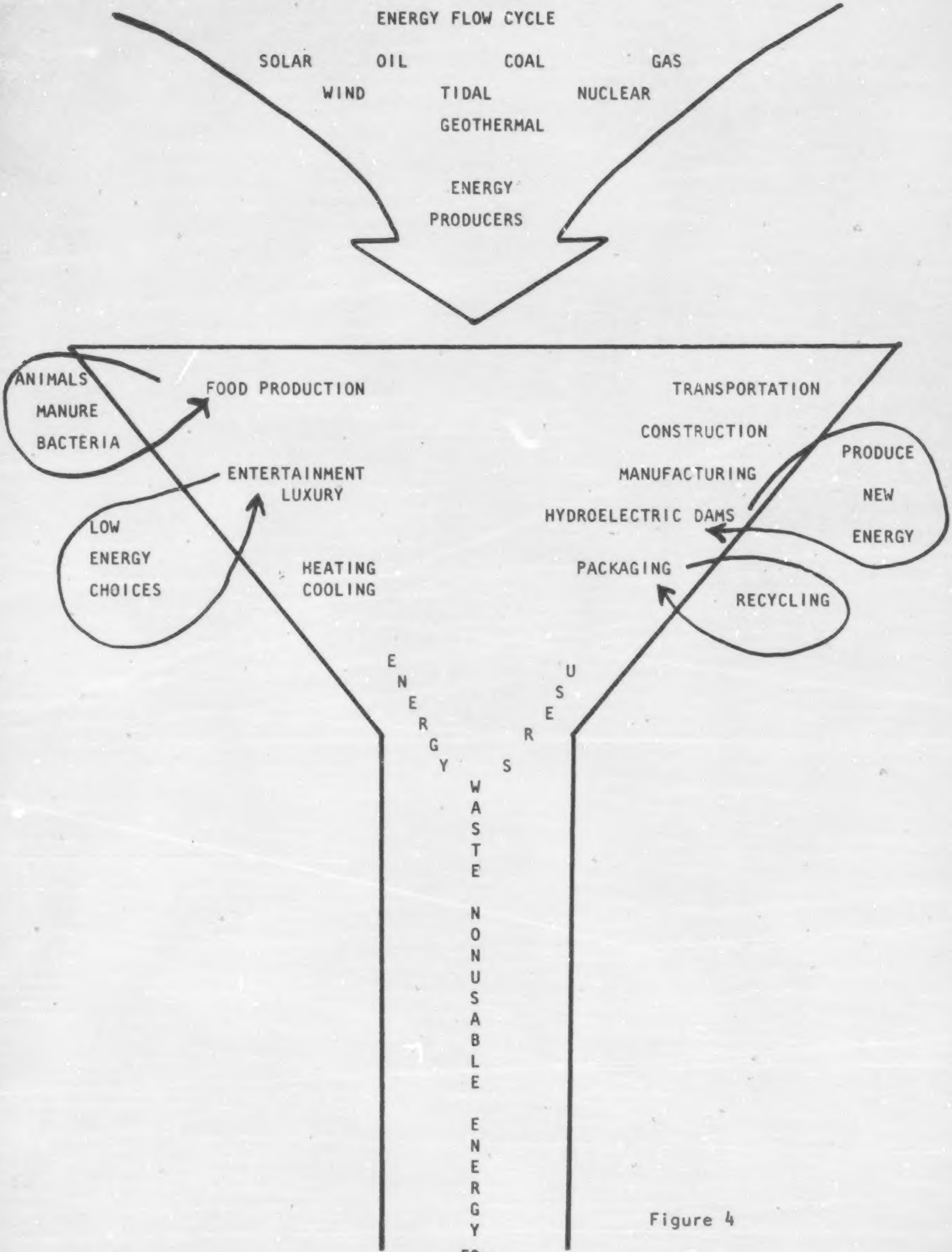

ENERGY FLOW CYCLE
SOLAR
OIL
COAL
GAS
WIND
TIDAL
NUCLEAR
GEOTHERMAL
ENERGY PRODUCERS
ANIMALS
MANURE
BACTERIA
FOOD PRODUCTION
ENTERTAINMENT
LUXURY
LOW ENERGY CHOICES
HEATING
COOLING
TRANSPORTATION
CONSTRUCTION
MANUFACTURING
HYDROELECTRIC DAMS
PACKAGING
PRODUCE NEW ENERGY
RECYCLING
ENERGY USERS
WASTE NONUSABLE ENERGY

Figure 4

OBJECTIVE:

To identify and apply the concepts of energy flow, biotic and abiotic cycles to the total environment.

Background: The number of organisms and their metabolic activity depend upon the rate at which energy flows through the trophic or feeding levels and upon the rate at which materials circulate through a system. This applies equally to all organisms and all environments and thus, two general laws or principles can be applied to the study of ecology. One law states that the flow of energy through a biological system is one way and is reduced with each succeeding trophic level. The second law refers to the circulation of raw materials. Energy is lost from the system but matter is recycled.

This energy and food intake and transfer occurs in food chains and food webs within ecological communities. Raw materials are used by green plants, are transferred to a higher feeding or trophic level when eaten by herbivores, and then by carnivores, and eventually, are decomposed and returned to the soil as water, carbon dioxide, elemental carbon, nitrogen,phosphorous, sulfur, calcium, and so on.

Let's trace the movement of raw materials through the trophic levels along the food chains of predator-prey relationships using a forest ecosystem as an example.

All food chains and food webs begin with green plants. Green plants capture the sun's energy and, using chlorophyll as a catalyst, convert carbon dioxide and water to food and oxygen. The rate of photosynthesis is important in determining how much life can be supported. Remember, much of the material produced by plants is also used by them and only about 10% can be transferred when eaten by herbivores. The sun's energy and the rate of photosynthesis then, are limiting factors in predicting the amount of food and energy that is contained in an ecosystem. Other limiting factors include the materials available,such as, water, carbon dioxide, oxygen, nitrogen, sulfur, etc.

The first trophic level is made up of the primary consumers or herbivores. In the forest ecosystem, these herbivores are birds which eat seeds, buds and foliage; insects which eat all parts of the plants; deer and rabbits which eat twigs and leaves, and gophers which eat the roots of plants.

In the second trophic level, the secondary consumers are carnivores which eat the animals in the first trophic level. The carnivores in the forest include hawks, owls, foxes, shrews, skunks, snakes, scavengers, birds, and insect-eating insects.

A hawk is also a tertiary consumer because he is a carnivore which consumes snakes and weasels. In some ecosystems, fourth level consumers also exist. For example, scavengers will eat dead hawks.

In addition to herbivores (plant eaters), and carnivores (animal eaters), there are omnivores and cannibals. Omnivores will eat plants and animals and cannibals eat one another. Mice will do the latter just to supplement their diet. The Eastern red fox is an omnivore because he eats mice, rabbits, birds, lizards, other small animals and also, fruits and seeds. Bears eat small mammals, snakes, fish, grasses, berries, fruits, leaves, bark and picnic lunches! Of course man too, is an omnivore because he eats meat, vegetables, fruits and nuts.

In the final trophic level, we find the decomposers. Decomposers, primarily bacteria and fungi (yeasts and molds), break up dead animals, plants, and waste material into simpler form and these compounds and elements are then used again by plants and are also recycled through the biological system.

In the predator-prey relationship, any organism is a potential prey of organisms in the trophic level above it. Organisms occupying the same trophic level are competitors for the same food supply. Have your students keep these factors in mind when they study and try to measure the relationships in any ecosystem whether it be a forest, grass prairie, desert, pond, ocean, or coral atoll.

ACTIVITY 1:

1. Have the students identify energy sources and materials used in the school and estimate the daily per capita use rates of each. For example:

   a. Land -

      1. determine total acreage of school grounds
      2. determine percentage amounts of land devoted to buildings, parking lots, playgrounds, athletic fields, tennis courts, lawn, forest
      3. determine condition of the land prior to the building of the school and modifications to it during the life of the school

   b. Building materials -

      1. determine the different kinds of materials employed in the construction of the school and school grounds
      2. determine the quantities of each material used in the construction of the school (Note: Blueprints and other information pertaining to the construction of the school are probably on file in the school superintendent's office.)
      3. determine to cost of the original school construction based on current costs of materials and labor

   c. Water -

      1. contact the community water department to determine the daily consumption rate for the school
      2. estimate the portion of the total water consumption employed in various activities in the school

d. Food -

  1. discuss with cafeteria personnel the amounts and kinds of food consumed each day
  2. determine the amount of food consumed by students who bring their lunches
  3. determine total daily food consumption
  4. estimate the total cost including space requirements and equipment over a period of twenty years

e. Paper -

  1. determine the paper use patterns (e.g., dittoed and mimeographed sheets, notebook paper, and graph paper)
  2. determine specialized paper uses (e.g., paper for mechanical drawing, art work, and office supplies)
  3. determine other uses of paper
  4. determine total daily paper consumption
  5. determine the percentage of paper that is used only on one side

f. Chemical compounds -

  1. determine the amount of duplicator fluid used
  2. determine the amount of detergents and other cleaning agents used
  3. determine the amount of paint used in art classes, and for maintenance purposes
  4. determine amounts of other chemical compounds used
  5. estimate the total daily quantity of various chemical compounds
  6. determine the flow pattern of these agents

g. Sources of energy -

  1. determine the amount of fuel oil, coal, and gas used
  2. determine the amount of electricity used
  3. determine other sources of energy and the amounts used
  4. determine the total energy demands made on a daily basis

ACTIVITY 2:

1. Have the student identify the different kinds of wastes produced during the normal operation of the school and discuss their findings. For example:

   a. sewage
   b. solid wastes
   c. smoke from heating plant
   d. heat
   e. waste water
   f. automobile and bus exhaust

2. Have students form teams to investigate the amounts of waste produced in each of the categories in the previous investigation and establish the flow pattern of these wastes.

3. Have students determine the extent of the school's contribution to the community waste treatment facilities
4. Have students identify untreated wastes resulting from the operation of the school.

ACTIVITY 3:

1. Have the students suggest a plan for reducing the production of wastes by:
   - a. reducing the use of materials which contribute to waste production
   - b. making better use of materials which produce wastes
   - c. increasing the efficiency of energy use
2. Have students study the evidence found in the school use patterns and make recommendations for changes. For example:
   - a. diminish paper use by increased use of chalkboard, intercom and overhead projector
   - b. use both sides of paper
   - c. regulate time for showering
   - d. turn off room lights except when absolutely necessary
   - e. repair dripping faucets

ACTIVITY 4:

Background: The decks of cards to be used in this game can be made by the students. Have teams of 4-6 select a community and decide on the organisms that are to be included in their food web. All decks must contain cards of raw materials, light, and molds, bacteria and yeast.

Students can also make the food web diagrams. This activity will involve some library research to determine eating habits of each animal. This should give the students some background information on producers, consumers, and decomposers which is necessary to play the game.

MATERIALS

Four food web diagrams - one for each community
Four decks of cards (the following are suggestions only)
Rule sheet

Pond Community

3 raw materials
4 light
3 algae
3 pond celery
5 daphnia
5 mayflies
5 beetles
2 frogs
3 turtles

Desert Community

3 raw materials
4 light
3 prickly pear cactuses
3 saguara cactuses
2 sage
6 grasshoppers
3 rabbits
3 desert rats
2 owls

2 minnows
2 bass
4 molds, bacteria, yeasts

2 roadrunners
3 lizards
3 scorpions
4 molds, bacteria, yeasts

Prairie Community

3 raw materials
4 light
3 corn
3 wheat
3 Indian grass
6 locusts
3 Quail
3 prarie dogs
3 hawks
3 rattlesnakes
3 humans
4 molds, bacteria, yeasts

Forest Community

3 raw materials
4 light
3 pine trees with pine cones
2 oak trees and acorns
2 deer
6 beetles
4 rabbits
3 squirrels
2 owls
2 foxes
2 weasels
2 bobcats
4 molds, bacteria, yeasts

RULE SHEET

1. Each team selects a dealer for the first round. (On the next round of play, the person to the dealer's left becomes the dealer.)

2. The dealer shuffles the cards and deals five cards face down to each of the other players and to himself. He places the remaining cards face down in the center of the playing area.

3. The player to the left of the dealer draws the top card from the deck and compares his six cards that represent one or more complete food chains as shown on the diagram (e.g., Desert Community: sage - grasshoppers - lizards; Prairie Community: corn - humans). He places these face up on the playing area in front of him. No player may play more than one of each population card. (After a card has been placed on the table, it may not be picked up unless there is an error.)

4. At the end of his turn, a player either holds the remaining cards in his hand or discards one card by placing it face up next to the desk. He then tells the person to his left that he is finished.

5. The next player draws a card and plays if he can. (A player may draw either the top card from the deck, the top card from the discard pile, or the entire discard pile.)

6. Play continues as each player adds population cards to the cards on his playing area. Each time a card is added, it must connect directly to a food chain. (In the Desert Community, for example, if a player has put down sage, grasshoppers, and lizards, he may add roadrunners or both desert rats and owls to form a food web. The addition of these populations is permissible because there is a food supply for each animal.)

7. The round of play ends when one player has a community (at least one food web and a Light card, Raw materials card, and Molds-Bacteria-Yeasts card) on the playing area and no cards remaining in his hand. He then says "I am out" to the other players. The other players can check his cards to see that every card was played correctly.

8. Each player's score is calculated and recorded. Then the next round can begin.

Scoring: For each card a child has on the table, he receives one point. Unplayed cards are not counted. The player who goes out gets three additional points. One player on each team should record the scores.

ACTIVITY 5:

Energy is frequently described as the capacity to do work, and work is considered to have occurred when a force causes an object to move. In terms of human activity, have students determine:

1. What kinds of work are done by the human body? For example:
    a. beating of the heart
    b. circulation of the blood
    c. walking
    d. running
    e. lifting
    f. breathing
    g. typing

2. Where humans get the energy used in maintaining their body functions (i.e., from food which they consume from their external environment).

3. How materials in the previous activity acquire energy (i.e., plants directly from sunlight and animals from plants).

ACTIVITY 6:

Have students determine other ways environmental energy influences the lives of people. For example:

1. It is needed to operate kitchen ranges, blenders, electric can-openers, automatic dishwashers, automatic clotheswashers, automatic clothes-dryers, steam irons, toasters, and clocks.

2. It is employed in home heating systems.

3. It is used in air-conditioning systems.

4. It is used to operate automobiles, motorcycles, trucks, buses, power lawn mowers, farm machinery, and air compressors.

5. It warms the atmosphere.

6. It warms surface waters of lakes, ponds, and rivers.

ACTIVITY 7:

Have students determine some basic energy sources available in the environment and to what extent they are convertible. For example:

1. sunlight - may be converted to electricity by means of solar cells
2. moving water - rapidly moving water drives hydroelectric plants to produce electrical energy and tidal flow can drive tidal generators to produce electricity
3. wood - burned to produce heat energy or wood converted to charcoal and burned for heat energy
4. coal - burned to produce heat energy or coal burned to produce heat which converts water to steam and drives equipment which generates electrical energy
5. oil - burned to produce heat energy or oil burned to produce heat which converts water to steam and drives equipment which generates electrical energy
6. natural gas - burned to produce heat
7. liquified petroleum products - burned to produce heat
8. nuclear energy - used to produce heat which converts water to steam to drive equipment which generates electrical energy
9. gasoline - a crude oil derivative burned to produce heat

ACTIVITY 8:

Examine each of the energy sources identified above and assess them in terms of their advantages and disadvantages in environmental terms. For example:

Energy Source	Advantages	Disadvantages
solar energy	virtually undepletable non-polluting	requires very large areas for heating water or generating electricity by means of solar cells, not always available because of clouds
moving water	available for long periods into the future	limited availability in terms of quantity and location

Energy Source	Advantages	Disadvantages
wood	a renewable resource	use as fuel competes with other uses, not uniformly distributed, incomplete combustion products contribute to atmospheric pollution

ACTIVITY 9:

Have students study the potential energy of foods to determine:

1. If people receive adequate amounts of food. If not, determine the consequences of inadequate food (in terms of energy requirements of humans).
2. The factors in his environment which influence the amount and kinds of food he consumes.
3. Some foods, carbohydrates, and fats that have higher energy potentials than other foods and the advisability of limiting one's diet to only those foods with the highest energy potential.
4. If all the energy were released from all of the food one consumes, what might become of any unexpended energy.
5. What becomes of the heat produced by the body through normal human activities.
6. What becomes of other products of energy transformation in the human body (e.g., carbon dioxide and water).

ACTIVITY 10:

Have the students make a list of all of his activities which require energy. For example:

1. generally - sunlight and food
2. in school - heating, air conditioning, office machines, kitchen appliances, floor buffers, lighting, clocks, and bells
3. at home - heating, air conditioning, lighting appliances, power tools, radio, television, and clocks
4. in the community - street lighting, cars, autos, trucks, buses, street-cleaning equipment, heating & air conditioning in buildings, electric utilities, and telephone service

ACTIVITY 11:

Have the students survey the various energy-requiring devices in their homes (use safety precautions) to determine:

1. which requires the greatest amount of energy
2. which requires the least amount of energy
3. which is the most expensive to operate

4. those essential for survival (your ability to continue living), and improvement in the quality of your life

ACTIVITY 12:

Have the students interview their grandparents or other older members of their community to get some insight into energy use patterns thirty, forty, and fifty years ago to determine:

1. the size of the community
2. the energy-requiring devices used by the townspeople
3. the difference in the lifestyle
4. the difference in the energy costs
5. the modes of transportation and compare the energy requirements and waste products of the different modes of transportation today
6. the extent of the concern for pollution and environmental degradation
7. the ways the lifestyle of the person being interviewed have changed between his childhood and the present and the rate of its occurrence

ACTIVITY 13:

Have the students determine the extent energy-related activities in the environment have had an aesthetic impact on him. For example:

1. utility poles
2. different types of smoke billowing from power plant stacks
3. truck and bus exhaust fumes
4. a lake (reservoir) behind a hydroelectric dam
5. radiators and heat vents in your home

ACTIVITY 14:

Have the students determine the years' cost and the percentage of the total family income of financing various energy-related activities. Include:

1. cost and efficiency of heating fuel
2. cost and efficiency of electricity
3. cost and efficiency of automobile fuel
4. cost of energy requiring appliances (divided by the number of years of anticipated usefulness)
5. cost and efficiency of firewood for the fireplace
6. cost and efficiency of various food

ACTIVITY 15:

Have the students determine the extent energy-consuming activities contribute to the degradation of the environment. For example:

1. heated effluent from power plants killing fish
2. exhaust gases from internal combustion engines polluting the atmosphere
3. smoke from industrial operations polluting the atmosphere
4. certain strip mining operations destroying the lands
5. oil-carrying ships spilling oil

ACTIVITY 16:

Have student determine:

1. the number of cars in the school parking lot which belong to faculty, administrators, and other school personnel
2. the number of faculty, administrators and other personnel
3. the average number of riders per car
4. a method of increasing the average number of riders per car so the use of fuel could be reduced
5. if there are other factors that should be considered

ACTIVITY 17:

Generally speaking, the faster an automobile is driven, the more fuel it requires to go a particular distance. Have students:

1. Discuss the reasons why people often travel at high speeds when they could save fuel by going more slowly.
2. Determining ways to reduce the speeds of moving automobiles. For example:
    a. manufacture cars with "governors" which prevent them from going faster than 50 miles per hour
    b. hire more law enforcement officers to enforce lowered speed limits
    c. post signs which indicate a maximum legal speed of 50 MPH
    d. encourage people to "report" anyone observed exceeding a speed of 50 miles per hour
3. Determine the advantages and disadvantages of each of the previous suggestions.

ACTIVITY 18:

Have student:

1. Scrutinize the various energy-requiring activities which occur in his home to determine if all are essential.

2. Suggest changes in energy use patterns in his home to lower the energy requirements
3. Suggest problems he might encounter in instituting energy conserving practices in his home.

ACTIVITY 19:

Have students determine:

1. those laws affecting the energy-requiring activities in his community
2. who makes these laws
3. in what ways residents of the community influence the creation of these laws
4. if we should guarantee the rights of each citizen to his opinions and set of values

ACTIVITY 20:

Have students identify different forms of transportation used in the community and the principal functions performed by each. For example:

1. walking - transports individuals and small numbers of relatively small objects
2. bicycles - transport one or two people and small objects
3. automobiles - transport one to several people, relatively small objects, and small quantities of objects
4. trucks - transport large and/or heavy objects or large quantities of objects
5. buses - transport large numbers of people and small quantities of objects
6. trains - transport large numbers of people, large objects, and/or large quantities of objects

ACTIVITY 21:

Divide students into groups of 5 or 6

MATERIALS
Auction sheet
Pencil

Give an auction sheet (see next page) to each student with the following directions:

1. The 20 items on the sheet are to be sold at auction to the highest bidder.
2. Pretend that you presently have none of the items listed.
3. You have a total of $5,000 to spend.

4. You can spend up to $2,500 (but no more) on any one item.
5. Bids must open with at least $50 but no more than $500.
6. All bid increases must proceed by increments of no less than $50 and no more than $100.
7. Try to spend all of your $5,000. Remember, you cannot spend more than $5,000.
8. Fill in the first column by yourself. As the auction proceeds, fill in the second and third columns.
9. What items do you feel are worth most? Discuss this with your group. What items received the highest bids by your group? Discuss these.

AUCTION SHEET

A long life free of illness			
Tickets to any cultural or athletic event you want			
The love and admiration of friends			
Television			
An unspoiled natural setting for your home			
Complete self-confidence with a positive outlook on life			
A complete library for your personal use			
A happy family relationship			
An automobile			
A large fruit and vegetable garden			
A very happy marriage			
The ability to speak many languages			
A chance to eliminate sickness and poverty			
Electricity			
A chance to preserve endangered species			
An understanding of the meaning of life			
Unlimited funds for the enjoyment of music			

A world without prejudice			
Commercially canned and frozen foods			
A world without air and water pollution			

ACTIVITY 22:

Have students answer the questions in the following inventory and then give it to 3 other people. Compile and discuss the findings made by the class.

Attitudes Inventory

1. Do you feel that we have an energy crisis?
2. Why or why not?
3. Do you personally do anything to conserve energy?
4. If so, what?
5. Do you encourage others to conserve energy?
6. Why or why not?
7. Do you think governmental restrictions should be imposed on the people in order to conserve energy?
8. If so, what restrictions?
9. How would you react to those restrictions?
10. How do you feel that most Americans would react, if any at all, to those restrictions?
11. Should there be severe punishment for violators of those restrictions?
12. Which of the following age groups do you fall in?
    (a) under 18 (b) 18-25 (c) 26-35 (d) 36-45 (e) over 45
13. Which of the following income brackets to you fall in?
    (a) \$3,000-\$6,000 (b) \$7,000-\$10,000 (c) \$10,000-\$20,000
    (d) over \$20,000

ACTIVITY 23:

The Newspaper - Propaganda Techniques - Select two newspaper/magazine articles on energy sources, etc. Cite examples of propaganda techniques (name calling, glittering generalities, band wagon, testimonials, card stacking, transfer, and plain folks) being used.

ACTIVITY 24:

Cause and Effect - The statements in this exercise follow each other in cause and effect. Draw up four (4) statements of your own, using this same cause and effect relationship, but relate it to the energy crisis (i.e., how man's use of our resources in the name of "progress" has led to their depletion).

1. Nations desiring power (cause) needed to possess colonies (effect).
2. Nations possessing colonies (cause) needed large armies (effect).
3. Large armies and navies (cause) meant large military budgets (effect).
4. Large military budgets (cause) meant (What effect can you insert here?)

ACTIVITY 25:

Decision Making - Assume that you must determine "the" energy alternative best suited for your state. Use the following procedure to arrive at your answer.

1. Define the problem.
2. Plan a method of investigating the problem.
3. Gather and evaluate the information found.
4. Decide and act on implementing your findings.
5. Evaluate the decision made.

ACTIVITY 26:

Interest/Pressure Groups - Find an environmentalist group, lobbyist or interest group in your State Capitol. Answer the following:

1. What are their goals?
2. What techniques do they use to influence politicians/educate the people?
3. How effective have they been in influencing legislation dealing with energy and/or the environment?
4. What energy alternative, if any, do they favor as a possible solution to the energy problem and why?

ACTIVITY 27:

Looking at Alternatives - Read the following quotation and have students respond to the questions below.

Americans need "an ethic of national thrift"; it should include minicars, severe gas rationing, fewer airplant flights, and - lay in the firewood- and end to central heating... In 1972, the 6 percent of the planet's inhabitants who live in this country used nearly 40 percent of the total energy consumed in the entire world. Two hundred million Americans use about as much energy for air conditioning as the 800 million mainland Chinese use for all purposes...the era of "cheap power" is over; a new era of thrift must be inaugurated. I am convinced that we can combine conservation and technology to redefine progress--and produce lifestyles that will be leaner and more fulfilling. In the words of Gandhi, our slogan should be: "There can be enough for everybody's need, but not enough for everybody's greed."

Source: "The Energy Crisis: A Radical Solution" by Stewart L. Udall World, May 8, 1973).

Which of the above statements are based on facts?
Which are reflective of values held by the author?

Do you agree with the author's statements of value? State your reasons for agreeing or disagreeing with him.

ACTIVITY 28:

Using the graphs below, showing oil and coal production and demand, have students draw inferences concerning what problems will arise in the future and propose solutions to those problems. Some probing questions that may aid in student responses could include:

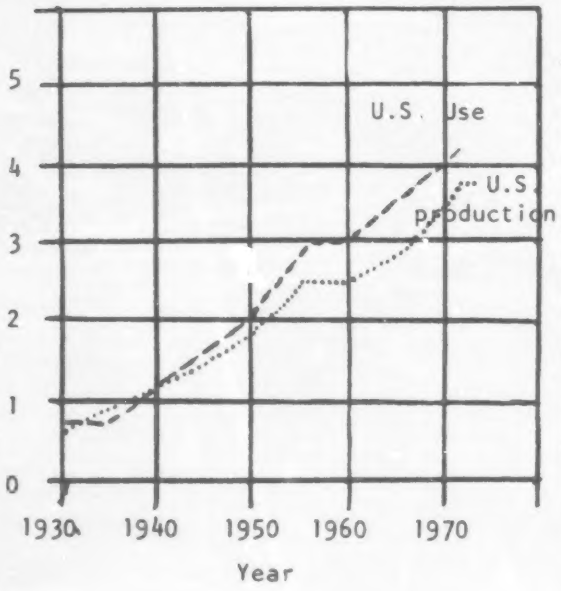
What has been happening to crude oil production?

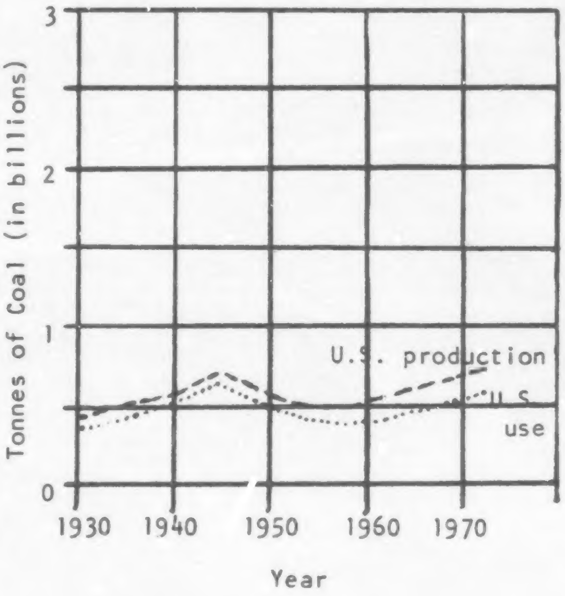
How is this related to use?

What consequences does this relationship suggest to you?

How do the figures for coal compare with those for oil?

Why do we not use more coal in the United States?





ACTIVITY 29:

To explore the concept of the role of government in the energy crisis as well as personal responsibility, the following developmental questions may be helpful.

Who would ultimately decide which method of energy generation is the best?

How can they implement such a decision?

Why does the government have the power and/or the responsibility to decide how we are going to live?

What if you can afford to buy all the energy you want regardless of price? Should you do it? Why or why not?

ACTIVITY 30:

From the following items, the student will list the energy consumed by each in its production and in its use. If the student had to cut his energy consumption drastically, which of these could he replace easily? Which would be more difficult? Which would be impossible?

Electric lighting
Electric cooling
Electric heat
Air conditioning
Mixer
Washer
Dryer
Synthetic fiber clothing
Wood frame house
Automobile
Stop lights
Street lights
Prefab house
Aluminum siding
Power lawn mower
Steam shovel
Electric toothbrush
Power saw
Plastic modular furniture
Dishwasher
Television
Radio
Stereo system
Road graders
Tractors

ACTIVITY 31:

Sentence Completions

1. Most of the world today has an __________ __________. energy crisis, energy surplus
2. Most cars and truck use ____________. gasoline, coal
3. Gasoline is made from _______________. natural gas, petroleum
4. Petroleum is the same as _____________ __________. hard coal, crude oil
5. Most homes in Alachua are heated by ___________ ____________. propane gas, natural gas
6. When oil drillers find oil they usually find ____________ ____________. propane gas, natural fas
7. The United States has a good supply of _______. oil, coal

8. Most of our electricity is now made by burning __________. coal, wood

9. Many people are saving heating fuel by burning _________. coal, wood

10. Much of our electricity in the future will probably be made from

_________________ energy. nuclear, gasoline

Energy Sayings

Each sentence describes some sort of movement (active or potential). Match the sentence with the phrase (A or B) that best describes the amount of energy being used.

____1. That guy moves around all the time.

____2. I really don't feel like doing much today.

____3. Gee, what a fast car!

____4. I'm really sleepy today!

____5. Wow! Look at that sailboat go!

____6. That boat isn't even moving.

____7. Hey! Did you see that guy pop a wheelie?

____8. He really hustles when he plays ball.

____9. I'm too tired to walk anymore.

____10. That hot rod really has a big motor.

A. Lots of Energy

B. Not much energy

ACTIVITY 32:

This Word-Find Puzzle introduces you to some of the most important words in the study of energy education. As you find the words on the left and right in the puzzle, circle them. They may be written vertically, horizontally, diagonally, or backwards.

1. energy
2. fossil
3. fuels
4. coal
5. natural
6. gas
7. crude
8. oil
9. heating

G A S O L I N E F H I G N
A A C K E R O S E N E S U
M T R B C D G H O M E U C
A O J E H E A T I N G N L
N M D F G L S O L I D H E
U S E S I E N E R G Y T A
F J K L F C W A T E R R R
A M M U N T A O P Q C A L
C O N S E R V A T I O N I

10. cooling
11. water
12. electricity
13. ocean
14. tide
15. fission
16. fusion
17. wave
18. transportation

19. manufacturing
20. solid
21. liquid
22. uses
23. kerosene
24. gasoline
25. nuclear
26. power
27. atoms
28. uranium
29. solar

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T N A O L I E S R S O S Q
J E B L S C O A L M L P U
R Y I A P I T V U S I O I
I U L R O T V E C C N R D
N W I X W Y L S F H G T F
G Y T Z E O O A O O B A I
T C Y D R I C E S O F T S
I G H T I L E J S L K I S
D R E C R E A T I O N O I
E P L M N O N P L Q R N O
S T H Y D R O P O W E R T
E N V I R O N M E N T Z W
F U S S I O N N M L K J S
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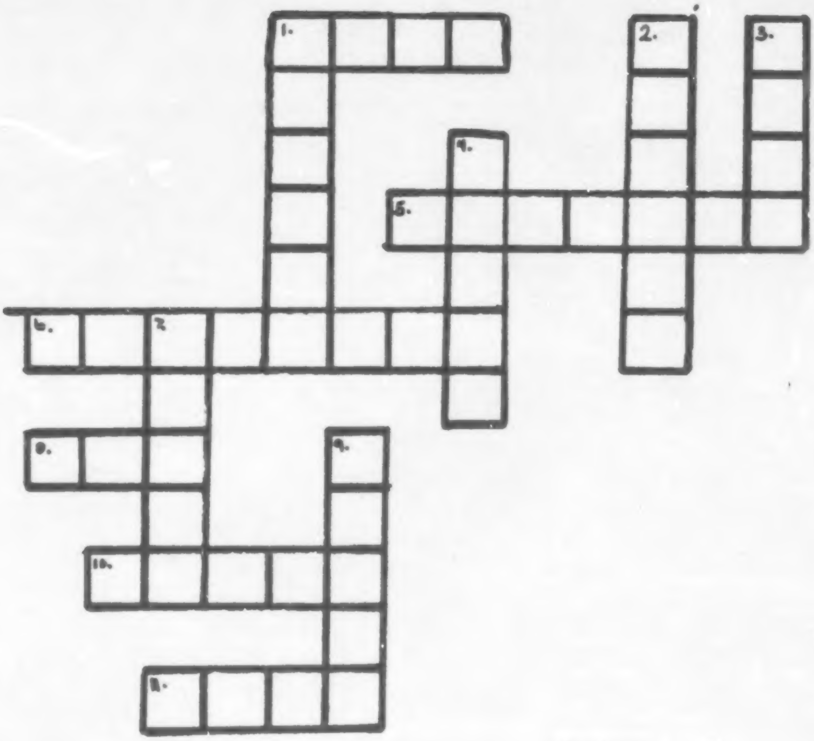
30. sun
31. hydropower
32. conservation
33. school
34. home
35. recreation
36. environment
37. money
38. saves
39. ability
40. petroleum

ACTIVITY 33:

CROSSWORD PUZZLE



ACROSS:

1. You need _______ to give your body energy.
5. ___________gas can be pumped to your home for heating and cooking.
6. Fuel for automobiles.
8. The first successful _________ well was drilled in the United States in 1859.
10. The thick liquid that is pumped from underground pools is called ____________oil.
11. Nuclear energy is energy released when an ________ is split apart.

DOWN:

1. Coal, natural gas, and oil are called ___________ fuels.
2. ________ is the power to make things move.
3. The Europeans were the first to mine __________ for heating.
4. In a steam engine, coal is burned to heat ____________.
7. Energy from the sun.
9. When water boils, ______________ is released to work for us.

ACTIVITY 35:

This simple ENERGY BINGO game is designed to provide students an entertaining way to become more aware of their surroundings and what can be done locally by themselves and others to aid in energy conservation.

1. Duplicate and provide a sheet for each student.

2. The student is to mark each block with an X when he actually finds what is described.

3. This should be an overnight home/school assignment.

4. The student receives 1 point for each square marked and a 5-point bonus for each complete diagonal, vertical, or horizontal row. He also receives a 4-point bonus for completing the 4 inner squares or 4 corner squares (but only 4 points, he cannot get 8 points for both). Total possible points - 110.

Follow-up:

After completing the game, have each student shade the blocks that represent wasting energy and leave the blocks that represent energy conservation clear (or color blocks 2 different colors).

Have a class discussion on why some save and some waste energy.

To better meet the needs of her students, the teacher may consider making her own game or revising this one to a larger or smaller version.

E	N	E	R	G	Y
Room w/thermostat set above 68 (summer-below 78)	Small portable electric space heater in use (electric fan in summer)	Color TV with instant-on feature	Car idling with no driver	Overheated public building (in summer-overcooled)	Car speeding over 55 mph (estimate)
Door or window open w/ heat or air conditioning on	Room or building where thermostate is lowered to 60 at night (80 in summer)	Lights on in an unoccupied room	Electric toothbrush in use	Open refrigerators in supermarkets	Washing machine using cold water only
Car accelerating smoothly and slowly	Solid state (no tubes) black & white TV	Dripping hot water faucet	House with no storm windows or storm doors	Lights on at midday in a hallway	Car coming to a quick stop (tires squealing)
Electric blanket in use	Car with only one passenger	Nighttime illumination of a public building	Water heater w/ thermostat set above 140 F	Gas pilot light burning	Outside light burning during the day
Mobile home or mobile classroom without underpinning	Car accelerating rapidly (tires squealing)	Car with a V-8 engine	Large wattage bulb used where a smaller one would do	Window air conditioner (in winter-without outside plastic cover)	Self-cleaning oven
Compact car with small 4-cylinder engine	Fluoresecnt tubes instead of incandescent bulbs	Frost-free refrigerator	TV or radio playing with no one in the room	Car easing to a smooth stop	Electric knife in use

ACTIVITY 36:

Take this quiz to check your knowledge and understanding of energy-environment issues.

1. How much of the energy used in gas stoves supplies the pilot lights?

   a. 10% b. 25% c 50%

2. How much of the energy stored in coal burned in a power plant can be delivered to the customer's home as electricity?

   a. 1/3 b. 2/3 c. all of it

3. What fuel is presently our most extensively used energy source?

   a. coal b. petroleum c natural gas

4. What fraction of radiation to which Americans are exposed comes from nuclear power plants and nuclear fuel reprocessing plants?

   a. 0.001% b. 0.1% c. 10%

5. How much of the energy stored in crude petroleum is lost in the series of processes between the oil well and a moving car?

   a. 20% b. 60% c. 90%

6. What fraction of the world's energy consumption occurs in the U.S.?

   a. over 10% b. over 20% c. over 30%

7. How long would a 100-watt light bulb burn on the energy needed to manufacture one throw-away soft drink can or bottle?

   a. 10 minutes b. 5 hours c. 20 hours

8. Where would you be exposed to more ionizing radiation?

   a. on a coast-to-coast jet flight for 5 hours
   b. at a nuclear power plant site boundary for 5 hours
   c. in your living room watching color TV for 5 hours

9. Which of the following fuel resources is in the greatest danger of exhaustion?

   a. coal b. petroleum c. natural gas

10. In the year 2000, American total energy demand will be:

    a. the same as today
    b. twice as much as today
    c. three times as much as today

*Energy Quotient

ANSWERS: Score 1 for each correct answer.

0 - 5 Poor
6 - 7 Fair
8 - 10 Good

1. (c) Approximately half of the gas used in a gas stove is used to fuel the pilot lights because pilot lights burn continuously.

2. (a) One-third of the coal's energy gets to the customer's home. Further losses in the customer's appliances results, on the average in a 94% net loss in the energy before it is ultimately used.

3. (b) In the U.S. 46% of our energy comes from petroleum. Natural gas contributes 32% and coal accounts for 17%. Dams and nuclear power plants account for most the the remaining 5%.

4. (a) Nuclear power plants account for almost none of the radiation to which Americans are exposed. The average American is exposed to:
40,000 times as much radiation from outer space
60,000 times as much from his immediate surroundings
25,000 times as much from his own body
100,000 times as much from his house if it is made of stone

5. (c) 94% of the energy in the gasoline from crude petroleum is lost in making your car move. The efficiencies of the most important steps where energy is lost are:

producing the crude oil	96%
refining	87%
gasoline transport	97%
engine thermal efficiency	29%
engine mechanical efficiency	71%
rolling efficiency	30%

The total efficiency of the system is found by multiplying the six factors together -- 6%

6. (c) More than 1/3 of the world's energy is consumed by the 6% of the world's population residing in the U.S.

7. (b) A 100-watt lamp could burn for 5 hours on the energy used to manufacture a disposable can or bottle.

8. (c)

	Relative Amount of Radiation
Nuclear power plant	1 unit
Jet flight	2 units
Watching color TV	10 units

9. (c) Natural gas reserves in the U.S. are expected to be exhausted in about 40 years. Petroleum should last for a century. Coal, 500 years or so.

10. (b) For more than a century, American demand for energy has doubled, on the average, every 20 - 25 years.

ACTIVITY 37:

According to the national wildlife magazine publication, "The Fifth Environmental Quality Index", there is only enough copper to last 38 years. This includes the 60% that is being recycled yearly. This figure is also based on consumption without solar water heaters.

Pretend you are a manufacturer of solar water heaters and you have just been assigned to build 2½ million water heaters. The president of the company wants you to fill out this questionnaire first.

1. What problems do you think you may encounter?
2. How long do you think you can stay in business?
3. How long do you think the resources it takes to build (copper, steel, glass, wood, etc.) the heaters will last before you run out?
4. As the resources start to run out what do you think will happen to the price of the resources that are left?
5. Will you have to raise the proce of the heaters?
6. Would you be smart to promise the government you will build all they want for a set price?
7. Will you be able to meet the demand when the population doubles?
8. What if more than 2½ million people want to buy the heaters, what will you do?
9. Will you raise the price of the heaters you have left knowing you will soon run out and be out of business?
10. Do you think the people who want them but can't get them will blame you?
11. Should you set up a public relations committee?
12. When the U.S. runs out of oil (about 20 years) and the people can't get electricity to heat their water will the people who couldn't get solar water heaters get mad and try to take them away from those you sold them to?
13. Do you think your company should try and invent another type of heater?

ACTIVITY 38:

Look at Figures 1-6. Then using the life styles of the U.S. vs. the rest of the world, have the students answer the following questions:

1. Do you feel that you as an American citizen have the right to use 50% of the world's resources while you are only 6% of the total world population. (For example we are 50% oil dependent)

2. Since the U.S. is 50% dependent of imported oil what do you think would happen if we could no longer import oil? Would the American people change their lifestyles or would they go to war to take oil by force?

3. To get our coal reserves we would have to dig up 38% of our land where houses, shopping centers and farms now exist. The energy it took to build these structures is greater than the energy we would get out of the coal we would dig up. (Net energy = energy to dig it up + energy to knock down structures and replace them after taken away from the energy we would get from the coal.)

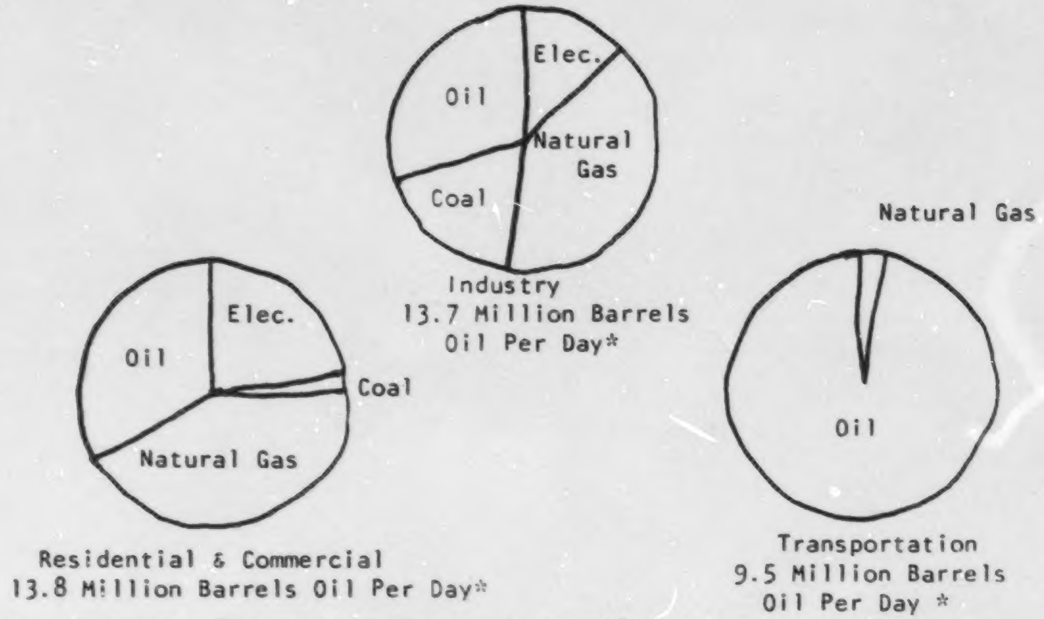
4. The U.S. is supposed to be one of the greatest technologically advanced countries in the world. Look at Figure 5 and explain why you think we haven't developed fuel economy cars.

5. Considering Figure 6, why do you think West Germany is more energy efficient in industry than the U.S.?

For future activities on energy, see POPULLUTION OR CONSERVIVAL Pages 91 to 106 and pages 158 - 178.

U.S. ENERGY CONSUMPTION BY SECTOR, 1976

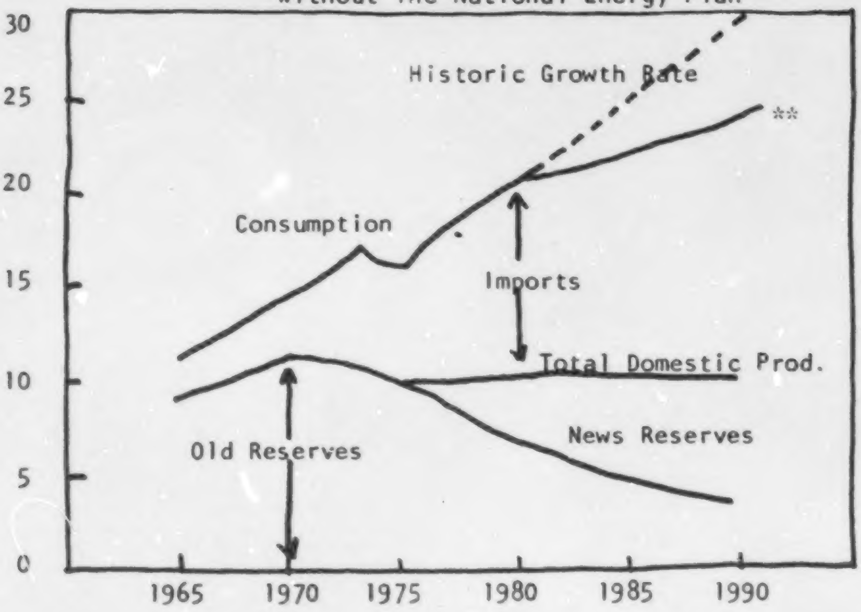
Figure 1



*Oil Equivalent (Electicity Losses Allocated)
Source: Federal Energy Administration

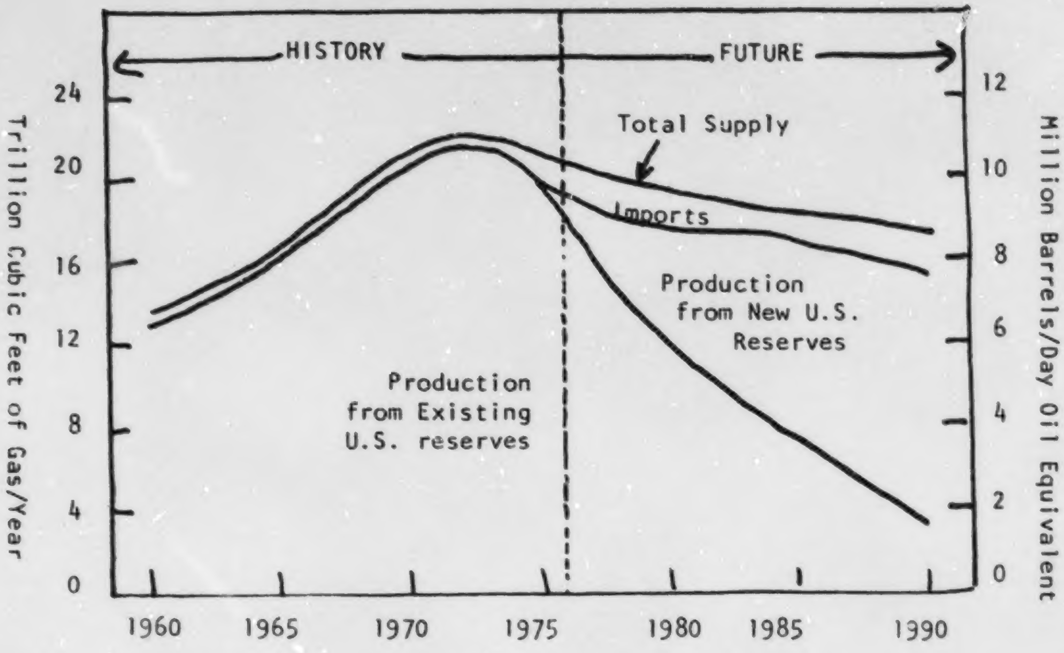
U.S. OIL CONSUMPTION
Without The National Energy Plan

Figure 2



*Includes Natural Gas Liquids
**Assumes Implementation of mandatory fuel efficiency standards and reductions induced by higher gasoline prices
Source: U.S. Bureau of Mines and Federal Energy Administration

U.S. GAS SUPPLY [1]

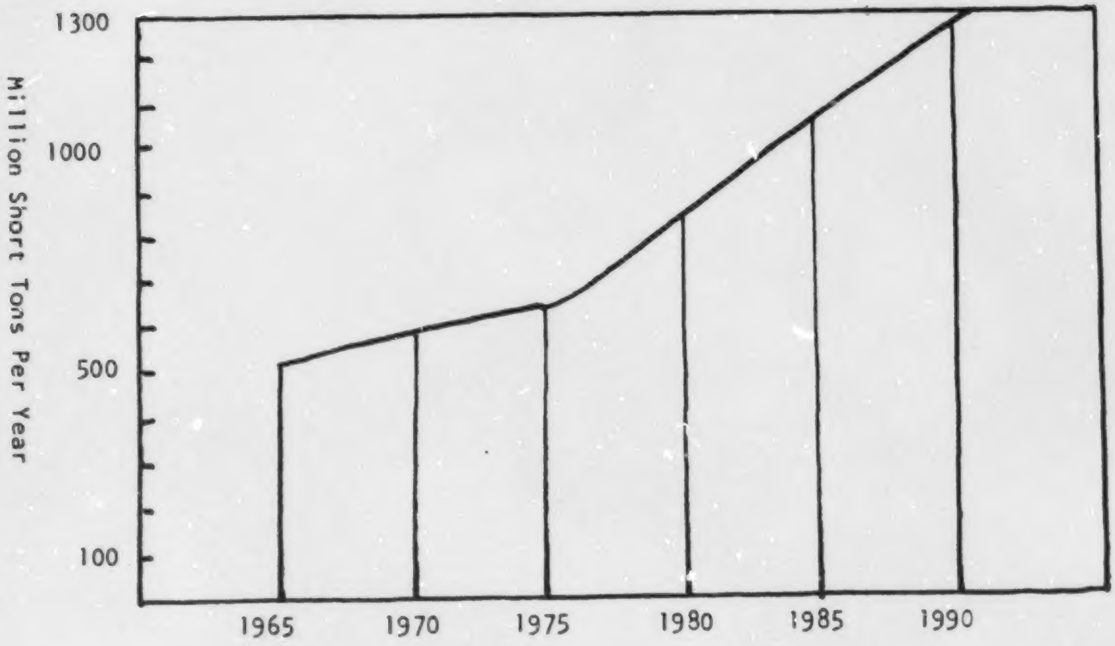


[1] does not include the effect of the National Energy Plan

Source: Federal Energy Administration

Figure 3

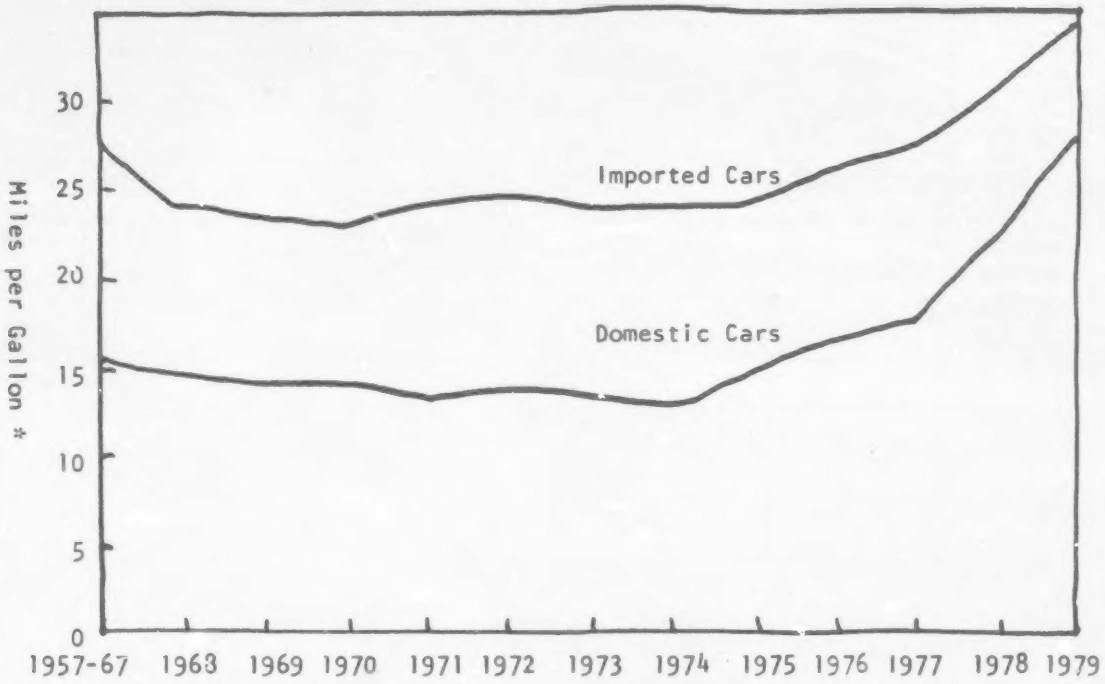
U.S. COAL SUPPLY



Source: U.S. Bureau of Mines and Federal Energy Administration

Figure 4

FUEL ECONOMY FOR NEW AUTOMOBILES



Note: *Salesweighted Average
Source: Environmental Protection Agency and Federal Energy Administration

Figure 5

U.S. INDUSTRY ENERGY EFFICIENCY COMPARED TO WEST GERMANY, for Major Energy-Intensive Industries

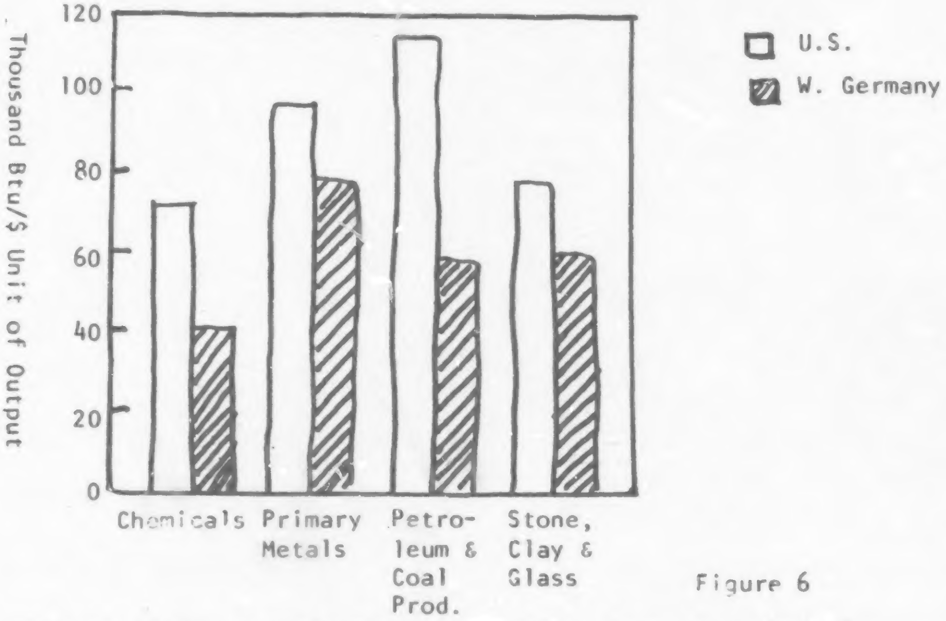


Figure 6

Source: Comparison of Energy Consumption Between W. Germany & the U.S., Stanford Research Inst. June 1975

OBJECTIVE:

To identify and describe man's relationship to his environment and his effects on it and the effect of the environment on man.

The problems dealing with man and his environment have been divided into the specific topics of:

- Water
- Air
- Noise
- Solid Waste
- Population
- Aesthetics
- Chemical Pollutants
- Radiation
- Nutrition

WATER

Background: Water is one of the most amazing substances on earth and because it is so common, we often take it for granted. At ordinary temperatures water is a clear, colorless liquid. Pure water (distilled or deionized) is flat and tasteless. The impurities in tap water give it a taste, In some areas, water is said to be hard because it contains salts, calcium and magnesium in the form of chlorides, carbonates, bicarbonates and sulfates. Soft water lacks these metallic salts. Pure water boils at 100 degrees Celsius and freezes at 0 degrees Celsius.

Water is called a universal solvent because more things dissolve in water than in anything else. This is an important factor in land erosion and in soil run off. Water dissolves the minerals in the soil and carries them to the streams, rivers and oceans. Fertilizer, which contains phosphates and nitrates, is washed into the lakes and streams and contributes to eutrophication.

Have your students ever wondered why the water in a pond freezes from the top down and not from the bottom up or why an ice cube floats in a glass of water? Most substances contract or shrink in size when they freeze but water expands. During the freezing process, water reaches its greatest density at 4 degrees Celsius. Thereafter, it begins to expand until it freezes at 0 degrees Celsius. Water is a polar covalent molecule as shown in Figure 1.

Since the Hydrogen part of the molecule is somewhat positive and the oxygen atoms are partially negative, the hydrogen of one molecule attracts the negative pole of another molecule. This attraction, attributed to the hydrogen bond effect, is responsible for the force that holds water molecules together. When water freezes, the molecules rearrange in a tetrahedron of hydrogen bonds around a water molecule, thus the water molecules are spaced farther apart. Look at the diagram of ice. (Figure 2)

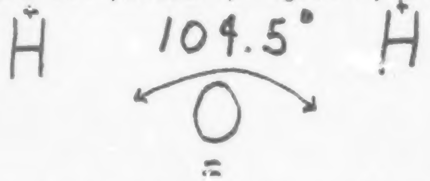


Figure 1: Water Molecule

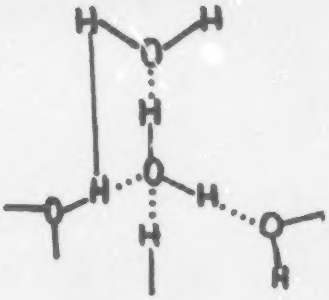


Figure 2: Ice

Water has many other unique properties. When objects are put in water they become wet. Why do water softeners make water "wetter"? When water falls, it forms drops. The surface of the water in a glass or graduated cylinder curves up along the sides of the glass. This is related to the hydrogen bond effect which exerts a force that holds the molecules of water together and is called cohesion. Adhesion is the force that is exerted between different substances such as the water and the glass. When we pour the water from the glass, the glass stays wet indicating that the force between the water and the glass is stronger than the cohesion forces. Water softeners break down the tension on the surface of water.

ACTIVITY 1

MATERIALS (per class)

- rain water
- plastic pan
- household iron filter
- paper cups - 2 per student
- 2 pitchers

Collect some rain water in a clean, well rinsed plastic pan or demineralize (deionize) tap water with a household iron filter. (Figure 3)

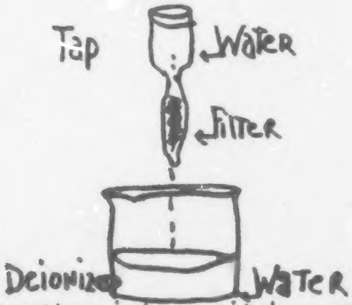


Figure 3.

Pour the water into a pitcher and label it "A." Run some tap water into a second pitcher and label it "B."

Obtain two paper cups and label one cup "A" and the other cup "B." Pour the water from the pitchers into the cups. "A" into "A," "B" into "B."

Taste the water in cup "A" first and describe the taste. Taste the water in cup "B" and write down a description of the taste.

Do you have an idea why tap water has a taste? Besides the metallic salts mentioned above, tap water has chlorine in it to retard bacterial growth and in some places, fluorine has been added to prevent tooth decay.

ACTIVITY 2:

MATERIALS (per class)	
	1 pint glass jar
	test tubes
	Calcium Hydroxide $Ca(OH)_2$
	Sodium Carbonate (Na_2CO_3)

Make up a stock solution of calcium hydroxide. Cover the bottom of a pint jar with calcium hydroxide and fill the jar with distilled (deionized or rain) water. Stir with a glass rod.

Deliver approximately 1 cm^3 of $Ca(OH)_2$ into a test tube containing tap water and 1 cm^3 into another test tube containing rain water.

Stir with a wooden splint or glass rod. Record your observations. The calcium hydroxide combines with the calcium hydrogen carbonate to form an insoluble, solid white precipitate, calcium carbonate, and water:

$$\underset{\text{calcium hydrogen carbonate}}{Ca(HCO_3)_2} + \underset{\text{calcium hydroxide}}{Ca(OH)_2} \xrightarrow[\text{yields}]{} \underset{\text{calcium carbonate (precipitate)}}{2CaCO_3} + \underset{\text{water}}{2H_2O}$$

Calcium hydroxide also combines with magnesium hydrogen carbonate and magnesium chloride to form insoluble magnesium hydroxide and calcium carbonate. If magnesium chloride is present, calcium chloride is also formed:

$$\underset{\text{magnesium Hydrogen carbonate}}{MgHCO_3)_2} + \underset{\text{calcium hydroxide}}{Ca(OH)_2} \xrightarrow[\text{yields}]{}$$

$$\underset{\text{magnesium hydroxide (precipitate)}}{Mg(OH)_2\downarrow} + \underset{\text{calcium carbonate (precipitate)}}{CaCO_3\downarrow} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2\uparrow}$$

$$\underset{\text{Magnesium Chloride}}{MgCl_2} + \underset{\text{calcium hydroxide}}{Ca(OH)_2} \xrightarrow[\text{yields}]{} \underset{\text{magnesium hydroxide (precipitate)}}{Mg(OH)_2\downarrow} + \underset{\text{calcium chloride (precipitate)}}{CaCl_2\downarrow}$$

Hold the test tubes to the light to see the formation of the precipitates. Let the test tubes stand until all the solid compounds have settled. To remove additional calcium ions, add washing soda (sodium carbonate).

$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 \downarrow + 2NaCl$

Calcium chloride + sodium carbonate yields calcium carbonate (precipitate) + sodium chloride

$CaSO_4 + Na_2CO_3 \longrightarrow CaCo_3 \downarrow + Na_2SO_4$

Calcium sulfate + sodium carbonate yields calcium carbonate (precipitate) + sodium sulfate

ACTIVITY 3:

MATERIALS (per class)

18-250 ml beakers	citric acid
water	moth flakes
alcohol	magnesium
benzene	magnesium carbonate
sugar	cooking oil

A solute is the substance that dissolves and the solvent does the dissolving. Prepare eighteen 250 ml beakers with three different solvents. Pour water, alcohol (denatured ethanol, methanol, or isopropyl alcohol) and benzene (cleaning fluid) into each of six beakers. Fill only ½ inch high.

Label the water beakers W1, W2, and so on. Label the alcohol beakers A1, A2, etc. and the benzene beakers B1, B2...

Add a teaspoon of sugar to beakers numbered 1. Stir with a glass rod or a wooden splint. Record observations on a chart according to the degree of solubility of each solute in each solvent - insoluble, slightly soluble, soluble, very soluble. (Chart No. 1)

Substance	Solubility in water	Solubility in alcohol	Solubility in benzene
1. Sugar	VS	SS	
2. Citric Acid	VS	VS	
3. Moth Flakes	I	S	
4. Magnesium	I	I	
5. Magnesium carbonate	I	I	
6. Cooking Oil			

ACTIVITY 4:

MATERIALS (per student)

medicine vial or small plastic container
magic marker or grease pen

Obtain a plastic medicine vial or some other small plastic container and fill it 3/4 full of water.

Mark the water level on the container with a magic marker or a grease pencil so you will know how much water has been added.

Place the container in the freezer.

When the water has frozen solid, remove it from the freezer and examine it. Does the amount of ice seem to be greater, lesser or equal to the amount of water originally put in the container? Does water exist in any other phase than in the liquid and solid phases? Does the molecular structure of water or the arrangement of molecules change as water changes from one phase to another?

Place ice cubes in water. What happens? What do your observations tell you about the density of ice and water? What is density?

ACTIVITY 5:

MATERIALS (per student)

plate glass 3" x 5"
balance
shallow dish
water

Obtain a piece of plate glass about 3" x 5" in size. Weigh it on a balance and record the weight.

Tie the plate of glass to the balance beam and lower it into a shallow dish of water.

Add weights to the other balance pan until the cohesive force holding the glass to the surface of the water breaks. Did this take more force than represented by the weight of the glass, less force or an equal force? What can you conclude about the strength of the hydrogen bonds that hold the water molecules together?

ACTIVITY 6:

Background: Density is a characteristic property which helps us distinguish substances from each other. If we were to take many samples of water from a gallon or liter of water, we would find that each sample would have the same mass. The mass of a given volume is a characteristic property of a substance and is useful in distinguishing between various substances. Density is the mass of one unit volume of a substance and is expressed usually as grams/cubic centimeter (g/cm^3).

We can find the density of a sample of any quantity of substance by measuring the mass, measuring the volume and then dividing the mass by the volume to obtain the mass per unit of volume.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}, \quad D = \frac{M}{V}$$

MATERIALS (per student)

balance
graduated cylinder
small beaker or measuring cup
water

In the graduated cylinder, measure 10cm^3 of water. This is the volume.

Find the mass of an empty beaker or measuring cup by using the balance.

Pour the 10cm^3 of water into the beaker.

Find the mass of the beaker plus the water.
Now calculate the mass of the water alone.
Remembering that density is determined by dividing the mass by the volume, find the density of 1cm^3 of water ($D = \frac{M}{V}$).

Mass of beaker + water ______________________

Mass of beaker alone ________________________

Mass of water alone _________________________

Density of 1 cm^3 of water __________________

A property of water that is very important to the inhabitants of a lake is that it becomes less dense, or lighter as it freezes. Therefore, when water freezes it floats. A covering layer of ice on the surface of the water prevents the lake from freezing solid, but it interferes with light penetration and oxygen exchange at the surface. In many lakes, living things can and often do, suffocate during the cold months of the winter season.

ACTIVITY 7:

Background: Increased population with its accompanying increases in homes has brought with it a problem of water contamination due to sewage disposal. Human excreta contains both pathogenic and non-pathogenic bacteria which can enter our water supply through the discharge effluent from sewage treatment plants or by leaching through the soil where private wells and septic systems are used.

A species of nonpathogenic bacteria which normally inhabit, in a commensal relationship, the large intestines of man and other animals is called a coliform. The most common occurring species (80-95% of all coliforms) in man is Escherichia coli (E. coli). Thus, the presence of E. coli in water is an indication of contamination by fecal matter and the probable presence of pathogens. Pathogenic (disease producing) organisms usually do not survive once they leave the host and therefore, the Public Health Service has established standards for coliform levels as an indication of the acceptability of the water for drinking, swimming, or other uses.

MATERIALS (per team of 2 or 3 students)

- pint or .473 liters water collecting bottle with screw top
- 6 plastic coffee can covers or 3 Petri dishes
- box of plain gelatin and boullion cubes or E.M.B. agar
- plastic tape
- felt tip marking pen or grease pencil
- medicine dropper
- toothpicks or inoculating loops

Wash your hands with soap and water. Mix up gelatin as directed on the box and add one boullion cube. Heat and pour into three plastic covers or Petri dishes. Cover them with another plastic top and let set. Prepare and use E.M.B. agar as directed on the label.

Prepare your water collecting bottles by washing them thoroughly and rinsing at least ten times. Do the same with the medicine dropper.

Collect your water sample from a pond, well, stream or elsewhere and screw on the top securely. Use immediately or store in the refrigerator or in a cool place out of direct light.

When ready to use your water sample, shake the bottle in a standard method, that is, seven times in the space of one foot or 30.5 cm; in an arc of 90 degrees in seven seconds. This is done in order to distribute the organisms uniformly.

Wash your hands to avoid contamination, and open one plastic covered plate to expose the gelatin. Quickly pour in 1 ml of water from your sample bottle. Rotate it to cover evenly. Replace the cover and tape it closed. Label it "1 ml water" and mark the date.

Take your clean medicine dropper and fill it one half full of your water sample. Deliver this amount on the side of a second gelatin plate. Streak the water over the gelatin with a clean toothpick or inoculating loop. Cover and seal it with tape. Label it "1/2 medicine dropper" and mark the date.

Leave the third gelatin plate as is without adding water. Tape it closed and label it "Control" and mark the date.

Incubate the three cultures in an incubator at 37 degrees Celsius for 24 hours, or in a warm, dark place at room temperature for 48 hours.

Examine your cultures after 24 or 48 hours. There should be evidence of growth on the agar or gelatin of the places inoculated with the questionable water. The control plate should not have growth on it.

Examine the growth with a strong magnifying glass or under a stereoscope. Describe. Do all the colonies look alike? Could there be more than one organism growing in the culture?

Soak plates in Lysol overnight and then discard.

ACTIVITY 8:

MATERIALS (per team of 2 or 3 students)

Presumptive Test sets (5 Durham fermentation tubes containing Lactose Broth)
Confirmative Test sets (5 Durham fermentation tubes containing Brilliant Green Lactose Bile Broth)
Test sets can be obtained from:

Hach Chemical Company
Box 907
Ames, Iowa 50010

Oceanography Unlimited, Inc.
1000 Clinton Street
Hoboken, N.J.

Wash your hands thoroughly with soap and water to avoid contaminating the test vials.

Remove a vial from the Presumptive Test set.

Carefully, unscrew the top. Do not touch the inside of the cap or vial. Fill the vial with the sample water to be tested. Screw on the top securely.

Invert the vial until the small tube inside is free of bubbles.

Repeat above with remaining 4 vials. Incubate the 5 vials in an incubator at 37 degrees Celsius for 24 hours or in a warm place for 48 hours.

After 1/2 hour, check the vials again for bubbles. Invert those which have bubbles in the inner tube to expel air. Continue to incubate.

Check tubes after 12 to 24 hours. If gas collects in the inner tube, coliform bacteria are assumed to be present. If no gas collects, incubate up to 48 hours.

If after 48 hours, no gas has collected, coliform bacteria are assumed to be absent from the test water sample.

Presence of gas in Lactose Broth may mean the presence of coliforms but it is not positive. Other bacteria may produce gas, and therefore, it is necessary to test further and to inoculate Brilliant Green Lactose Broth.

Remove the vials from the Confirmative Test set. Invert the Presumptive Test vials showing gas in the inner tube. This insures that some bacteria are on the screw top cap.

Carefully, transfer a wet screw top cap from the Presumptive Test vial to the Confirmative Test vials. Repeat until all caps have been transferred from the positive Presumptive vials to the Confirmative vials.

Incubate as above.

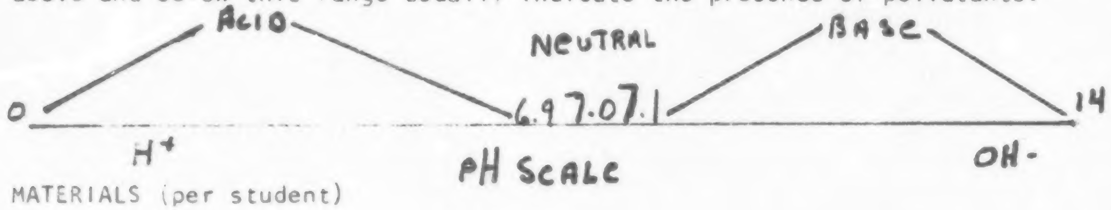
Presence of gas in the Confirmative Test vials confirms the presence of coliform organisms in the test water. The presence of coliform bacteria indicates the sample water was contaminated with fecal material which may or may not also harbor pathogenic (disease causing) organisms like typhoid, dysentery, etc. The number of coliform bacteria per 100 ml. of water can be estimated by the number of tubes containing gas as follows:

Number of tubes containing gas	No. Coliforms/100 ml
0	none
1	2.2*
2	5.1
3	9.2
4	16
5	over 16

*Less than 2.2 coliforms/100 ml is the acceptable amount for drinking water according to the 1962 U.S. Public Health Drinking Water Standards.

ACTIVITY 9:

Background: Briefly, pH refers to the concentration of positive hydrogen ions and negative hydroxyl ions in water. Water with a pH or 7.0 has equivalent hydrogen (H+) and hydroxyl ions (OH—) and is neutral. A pH of less than 7.0 has a higher concentration of hydrogen ions and is acidic. A pH above 7.0 has a higher concentration of hydroxyl ions and is alkaline or basic. Most fresh water lakes have a pH range between 6.5--8.5. Extremes in pH above and below this range usually indicate the presence of pollutants.



MATERIALS (per student)

- litmus paper
- hydrion paper
- 5 clean glass jars
- forceps

Collect samples of water in a clean, well rinsed jar.

Select several locations for sampling and take at least 5 samples and label the jars. Using forceps, dip a piece of red litmus paper into each of the five jars. Use a different piece of litmus paper for each jar. Record your observations.

Red litmus turns blue in base.
Red litmus remains red in acid.
Red litmus remains red if solution is neutral.

Repeat the procedures in number 3 above using Blue Litmus paper.

Blue litmus turns red in acid.
Blue litmus remains blue in base.
Blue litmus remains blue if solution is neutral.

Discard the neutral water samples and continue to test with hydrion paper. Hydrion paper is more specific and will give a more accurate pH reading between 1 and 14. Dip the hydrion paper into the water sample and compare the color change, if any, with the standard on the chart attached to the container.

ACTIVITY 10:

Background: Without oxygen, most organisms cannot live. Aquatic life makes use of the oxygen dissolved in the water. Therefore, dissolved oxygen (DO) content can be used as an index of water quality.

A simple method for determining the amount of DO in water is the Methylene Blue Procedure. In oxygen rich water, methylene blue retains its dark blue color. In oxygen poor water, methylene blue fades until the solution is clear, indicating that little or no oxygen is present.

MATERIALS (per class)

Methylene Blue indicator solution
Test tubes
water collecting bottles
watch with sweep second hand or timer
stoppered medicine vials

Methylene Blue Procedure:

Pour 10 ml of sample water in a test tube. Add 2 ml of Methylene Blue to sample water. Record the amount of time it takes for the color to change from dark blue to light or clear.

Repeat the procedure for the same water supply. Repeat the procedure for other water samples and compare.

The faster the color change takes place, the less oxygen is present, the more carbon dioxide is probably in the sample, and the more bacteria are in the water. Make up a set of Standards (use medicine vials) from +1 to +4 indicating the concentration of DO in the water. Let +1 be the oxygen poor concentration and +4 the oxygen rich concentration. In which samples do you find the oxygen rich water, that is, from which source or sources do your oxygen rich samples come? Would you expect to find a high DO concentration in the rapids of a stream or a low DO concentration? Try to explain your reasoning.

ACTIVITY 11:

Background: The chemicals present in our water supply are from two sources: (1) those naturally present such as carbonates which may come from the rock layers through which the water has passed; or, (2) sulfates, phosphates, nitrates and chlorine which are still present in the effluent that is discharged as treated from sewage treatment plants.

Approximately one third of the public sewage treatment plants in the Unived States are only primary treatment plants. These are designed to remove sticks, papers, sludge, and debris which can be trapped by screens. Secondary treatment, coupled with chlorination, effectively removes 90 percent of the degradable organic waste and 99 percent of the "germs" in the water. Privately owned septic systems might be compared to secondary treatment plants without the chlorination feature.

Tertiary sewage treatment, which utilizes filtration, flocculation, and other mechanical and chemical processes, removes almost all of the contaminants from water. But tertiary treatment plants are terribly expensive to construct and maintain, consequently there are very few in existence. Phone or visit your local treatment plant, and ask the sanitary engineer which process they use to treat the sewage.

It should be easy to see how phosphates, nitrates, and sulfates from detergents, and chlorine from bleach, can find their way back into our water supply. Additionally, the runoff from surface water eventually carries the sulfates, nitrates, and phosphates from garden fertilizers as well as chemicals from pesticides and insecticides into our streams and rivers which ultimately become someone's domestic water supply.

The Federal Housing Authority (F.H.A.) requires that water be analyzed before approving loans on certain property. Water is tested for nitrates, detergents, chlorides, iron, manganese, hardners and pH. Iron is undesirable because of the damage it does to the fixtures and clothes. Manganese damages the pipes and stains the plumbing fixtures. Hardness refers to the degree water can form lather from soap.

Hard water usually contains the dissolced chemicals magnesium chloride ($MGcl_2$), magnesium sulfate ($MgSO_4$), calcium chloride ($CaCl_2$), and calcium sulfate ($caSO_4$), or the bicarbonates of the metals. Soap will dissolve easily in soft water to form suds but no suds will form in hard water. The salts above react with the soap to form insoluble products which eventually settle (precipitate).

The pH is also important because if water is too acidic, it can damage plumbing equipment and pipes.

MATERIALS (per team of 2 or 3 students)

- distilled or deionized water
- water sample to be tested
- 2 500 ml flasks
- pure soap (Ivory flakes, castile, etc.)

Fill a 500 ml flask with distilled water. Add 1 tablespoon of soap. Shake and let stand a few minutes.

Fill a second 500 ml flask with water to be tested. Add 1 tablespoon of soap. Shake and let stand a few minutes.

Compare both flasks. What do you observe? Is your sample water hard or soft? To what degree might you describe its hardness?

ACTIVITY 12:

MATERIALS (per team of 2 or 3 students)

- red and blue litmus paper
- hydrion paper
- pH meter
- forceps
- 400 ml beaker

Using forceps, insert one strip of red litmus paper in your sample water. If it turns blue, the water is basic. If it remains the same color, the water can either be neutral or acidic.

Repeat No.1. using Blue Litmus. If the blue litmus turns red, the water is acidic. If it remains blue, the water is either neutral or basic.

Record your results. Why is it necessary to use both Red and Blue Litmus together rather than using only one or the other? Once you have determined that your sample water is acidic or basic, test with Hydrion paper and compare its color with the chart on the Hydrion paper container to get a more accurate pH reading. Record.________________

If a pH meter is available, lower the electrodes into a beaker of sample water. Turn the dial and record the exact pH of your sample. How acidic or basic is it?

ACTIVITY 13:

MATERIALS (per team of 2 or 3 students)

44 N standard sodium hydroxide
0.5% phenolphthalein indicator
250 ml Erlenmeyer flask
25 ml Burette
Burette stand
Burette clamp

Without agitating, pour 200 ml of water to be tested into the Erlenmeyer flask. Stopper immediately until ready to use.

Fill the Burette with the Standard NaOH for titration. Remove stopper from the water and add 5 drops of phenolphthalein solution and begin to tritrate the NaOH into the flask immediately one half to one drop at a time. Swirl the flask after each drop.

Stop immediately when the pink color remains in solution. Record the amount of NaOH needed to neutralize the CO_2 dissolved in water. Multiply this number by 5 and you will have the amount of free CO_2 in the water in ppm.

Tests for some of the other chemicals mentioned in this chapter are complicated. However, many commercial companies have developed simplified methods of testing for the presence and concentrations of chemicals found in water. You might want to obtain kits so your students can run tests on chlorine and chloride, detergents, iron, manganese, and nitrates. You may wish to contact Hach, Oceanography Unlimited or LaMotte Chemical Companies regarding their kits.

LaMotte Chemical Products Co., Chestertown, Md. 21620

Hach Chemical Company, Box 907, Ames, Iowa 50010

Oceanography Unlimited Inc., 1000 Clinton St., Hoboken, N.J.

ACTIVITY 14:

Background: The demand for more electric power continues to increase, presenting a dual problem. Without more power plants, the United States faces a critical electrical power shortage, but on the other hand, the more power plants we have, the more air and water pollution results. According to the environmentalists, electric power plants are among the worst polluters. Although the answer to the power shortage seems to be nuclear energy, atomic plants present a radiation hazard and heat up the water causing thermal effects. By changing the temperature of the water, the environment of the plants and animals living in the area is also changed.

The nuclear power plants use water in lakes and rivers to cool the reactor. The water never comes in contact with the radioactive core or nuclear fuel itself but just circulates in an outer protected jacket and absorbs heat. The water is then returned to the natural body of water at a higher temperature, sometimes up to and more than 23 degrees warmer than when it entered the power plant. The methods by which water is returned vary with the location of the nuclear power plants. Some use cooling towers, others long canals.

Research on what happens to the plants and animals living in an area where the water is warmed continues. Thus far, findings indicate that some effects are harmful and others are not. What can your students add to this information?

MATERIALS (per team of 2 or 3 students)

aquarium and accessories
water plants and animals
thermometer
aquarium heater

Look up how to start fresh and salt water (Marine) aquariums. Decide on which one you want to set up and obtain the materials you need. Look up the conditions necessary for your plants and animals to live well. Pay particular attention to the temperature range that is recommended.

After a week or two, your aquarium should be stabilized and you are ready to experiment.

Raise the temperature a few degrees every four days until you reach the lowest maximum temperature for survival of one organism in your tank.

Thereafter, raise the temperature only one degree more and record all your observations. Did the rise in temperature change the behavior of the organisms in your aquatic ecosystem? Did they remain healthy? Did they adjust to the temperature change?

ACTIVITY 15:

MATERIALS (per student or team of 2 or 3 students)

6 pint jars exactly alike
6 laboratory thermometers
various elements, detergent, bleach, manure, garbage, etc.

Standardize the thermometers by placing them in the same jar of tap water undisturbed for at least 15 minutes. Select the thermometer with the highest reading and record the differences of each thermometer on a piece of making tape and tape it on the thermometers. Add this number to your readings.

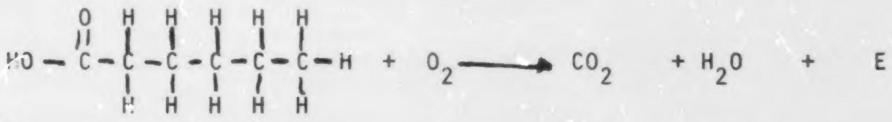
Place various materials in your jars such as mentioned above. Fill each jar to the same level with tap water. Fill one jar with tap water only and lable it "Control."

Place the jars in the sunlight or in a warm place. Let stabilize for 15 minutes and then begin to record the temperature of each jar. Leave the thermometers in the jars and record the temperatures every 15 minutes until no more changes have taken place.

Record other observations you can make of your jars. What conclusions can you draw regarding the addition of various pollutants to water supplies?

Background: The water ecosystem is a dynamic one that fluctuates from too much oxygen to not enough. Oxygen is produced by the green plants during periods of sunlight. If there is an excessive increase in algae growth, much oxygen is produced. This increase in algae resulting in an algae bloom is caused by an increase of organic matter, phosphates and nitrates. The organic matter can come from fecal materials or decaying plants and animals. The phosphates come from fertilizer and detergents; the nitrates, from fertilizers.

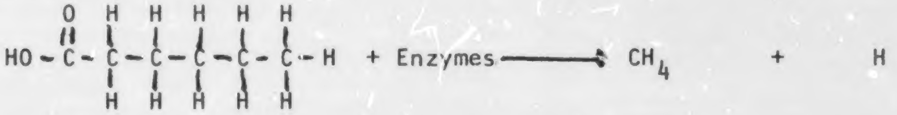
Although plants produce oxygen during the photosynthetic process, they also respire and use up much of the oxygen produced. The processes of decomposition and decay also consume oxygen. As in aerobic respiration, oxygen combines with the organic compounds to break them down. The resultant products are carbon dioxide (CO_2), water (H_2O), and heat energy.



$$HO-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-H + O_2 \longrightarrow CO_2 + H_2O + E$$

organic compound + oxygen yields carbon dioxide + water + energy

Anaerobic bacteria decompose organic matter also and as the DO decreases, the anaerobic bacteria become more active. The products of anaerobic decomposition are methane gas and active hydrogen.



$$HO-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-H + \text{Enzymes} \longrightarrow CH_4 + H$$

organic compound + enzymes yields methane + active hydrogen

The hydrogen formed quickly combines with nitrogen (N_2) forming ammonia gas (NH_3), sulfur (S) forming sulfite (SO_3) or sulfate (SO_4) ions or hydrogen sulfide (H_2S). When these products and other gases reach certain proportions - 80% CH_4, 1.2% NH_3 and H_2S, 18% CO_2-- their odors can be detected.

Pollutants and temperature influence the DO content. Cold water can hold more dissolved oxygen than warm water. As the molecules of water spread upon warming, the oxygen escapes into the atmosphere.

McKee and Wolff determined the minimum dissolved oxygen required for survival of fish within an 84 hour period. (Chart No. 2)

Chart No. 2
MINIMUM DISSOLVED OXYGEN REQUIRED FOR SURVIVAL OF FISH FOR 84 HOURS
(Milligrams per liter)

Fish Variety	Minimum concentration required for survival at indicated temperature		
	10 /C	16 C/	20 C/
Rainbow Trout	1.89	3.00	2.64
Perch	1.05	1.34	1.25
Roach	0.65	0.71	1.42
Mirror Carp	0.48	0.73	3.74
Tench	0.35	0.54	—
Dace	—	1.14	—
Bleak	—	1.50	—

ACTIVITY 16:

MATERIALS (per class)

Prepare the necessary reagents as follows for the Winkler Method of DO Determination.

1. Manganous sulfate. Weigh out480 grams of $MnSO_4$. $4H_2O$ or 400 grams of $MnSO_4$. $2H_2O$. Pour it into a 1 liter volumetric flask and bring it up to volume with distilled water.
2. Alkaline iodide. Weigh out 500 grams of NaOH (or 700 grams KOH) and 135 grams NaI (or 150 grams KI) per liter of distilled water.
3. Concentrated sulfuric acid. Specific gravity 1.83 - 1.84. Approximately 36 Normal H_2SO_4. Use as it.
4. Sodium Thiosulfate:
   a. Stock, o.1 Molar, weigh out 24.82 grams $Na_2S_2O_3$. $5H_2O$ and add enough water to make 1 liter. To preserve it, add 5 ml of ammonium chloride and chloroform per liter
   b. Standard thiosulfate - 0.025 Molar. Dilute 250 ml of Stock solution to 1 liter. Add 5 ml chloroform per liter. Make up fresh 0.025M thiosulfate solution each time because it deteriorates rapidly.
5. Soluble starch solution: 1% prepared fresh. Grind 1 gram soluble starch in a little water to form a paste. Add 100 ml of boiling distilled water.

Also have 250 ml ground glass, stoppered bottles for taking samples and 3-10 ml graduated cylinders or 3-1 ml pipettes.

Winkler Procedure:

A. In the Field: (per student or team of 2 or 3 students)

1. Add 1 ml of manganous sulfate and 1 ml of alkaline iodide to each 250 ml glass-stoppered sampling bottle.

2. Fill the bottles over the top so as not to trap air and stopper tightly. Take samples early and late in the day, for example, 9:00 a.m., 11:00 a.m., 1:00 p.m., and 3:00 p.m.

3. Place thumb over the stopper and swing back and forth in an arc to mix reagents with the water. Shake for 1 minute to distribute the precipitate that forms.

B. In the Laboratory: (per student or team of 2 or 3 students)

4. Add 1 ml of 36 Normal H_2SO_4 slowly down the inside of the bottle to acidify the mixture. Stopper carefully.

5. Shake again in the same manner until everything is distributed evenly.

6. Measure out a calculated amount of the sample in a graduated cylinder and transfer to a 400 ml beaker for titration.

Calculation for step 6

$$\text{Amt. of sample for titration} = 200\text{ ml} \times \frac{\text{original volume of sample (250 ml)}}{\text{original volume of sample (250 ml) less total volume of reagent added (2 mg) not corrected for acid}}$$

7. Fill the volumetric burette with 0.025 N thiosulfate and titrate into the sample very carefully until the iodine fades to a pale straw color.

8. Add 2 ml of starch solution to the sample and titrate until the blue just disappears. Be careful not to go beyond the end point. (Molecular Iodine (I_2) has been reduced to the iodide ion (I^-).

9. Record the amount of 0.025 N $Na_2S_2O_3$ that was used to reach the end point. Since 1 ml of $Na_2S_2O_3$ is equivalent to 0.2 mg of oxygen, the number of milliliters of thiosulfate solution used is equivalent to the mg/liter of dissolved oxygen (DO) if a volume of 200 ml of the original sample was titrated.

10. Record the milligrams per liter of DO in your sample.

11. Calculations for parts per million (ppm)
For a 250 ml bottle:

$$\underset{\text{constant}}{K} = \frac{\text{volume of bottle (250 ml)}}{\underset{(250\text{ ml})}{\text{volume of bottle}}\ \text{minus}\ \underset{(2\text{ ml})}{\text{volume of reagents}}}$$

$$\text{ppm (parts per million oxygen)} = K \times 200 \times \frac{\text{volume of 0.025 N thiosulfate acid}}{\text{volume of sample titrated}}$$

ACTIVITY 17:

Background: Normal succession (the orderly and progressive changes that take place in nature) in bodies of water takes place gradually and over a long period of time. In fact, in natural areas untouched by man, it is difficult to find evidence of these changes within one's life time. When man, however, tampers with nature the process of succession is often accelerated. As bodies of water age, they become warmer and shallower. Both factors tend to increase the amount of living things in the water. When the productivity of the water has reached the adequate nourishment stage, the body of water is termed eutrophic. The process of increasing productivity is call eutrophication. When this process is speeded up by pollution far beyond normal succession rates, the body of water is doomed to an early death.

We can find evidence of rapid eutrophication caused by pollutants by examining the change in communities of plants and animals. For example, as lakes become shallower and warmer, fish preferring cold, deep waters move out, and fish preferring warm, shallow water move in. Thus whitefish, walleye, coho, salmon, trout, and lake herring (char) move out and are replaced by bass, pike, and smelt. When eutrophication and pollution become more severe, sunfish, carp, and catfish also move in.

Evidence of eutrophication can also be found by examining the animal populations on the floor of a body of water. As streams and lakes begin to fill in, the bed becomes covered with silt and mud. Burrowing animals requiring little oxygen begin to appear. Suggest to your students that they look for sludge worms (Tubifex), leeches, sow bugs (Asellus isodid), and bloodworms (Chironomus larva). They should also find the mosquito larva (Culex), the bee fly (robberfly or hover fly, Eristalis), and the mothfly (sewage fly, Psychoda). Although these animals require oxygen, they inhabit deoxygenated waters and survive there because of their ability to take in oxygen through air tubes protruding from their bodies.

The most obvious evidence of eutrophication is the presence of algae growth on a body of water. You might think that these tiny one-celled green plants would provide abundant oxygen and food for supporting life but, to the contrary, they block the penetration of light reducing the ability of water plants to carry on photosynthesis which produced food for them and oxygen for the animals. Algae grow in all water sources, ponds, lakes, ditches, puddles, ocean water and so on. The presence of algae in water is normal and under normal conditions. they are essential to life. It is only when there is an alga bloom or an overabundance of algae that they do damage.

Apparently, only certain kinds of algae can be used as indicators of pollution. Of the blue-green algae, Anabaena, Aphanizomenon, Anacystis and Microcystis are most common. Of the green algae, Spirogyra and Chorella are very tolerant of polluted water and the common flagellates, indicate rapid eutrophication is taking place.

Coliform bacteria and perhaps zooplankton also contribute to the eutrophication process and their presence indicates that the water is polluted.

KEY POINTS

Key Points and Activities

A checklist for determining whether or not rapid eutrophication is taking place as a result of pollution:

____perch
____bass
____pike
____smelt
_____sunfish
____carp
____catfish
____sludgeworm
____leech
____sow bug
____bloodworm
____mosquito larva

Evidence of Eutrophication

____bee fly
____moth fly
____Anabaena
____Aphanizomenon
____Anacystis
____Microystis
____Spirogyra
____Chorella
____Euglena
____Chlamydomonas
____Coliform bacteria
____Zooplankton (?)

GLOSSARY

Bacteria - microscopic, one-celled, plant-like organisms belonging to the Kingdom Protista. Classified into four major groups according to their feeding habits: saprophytic, which feed on dead organic matter; commensal, non-parasitic bacteria which inhabit living systems; parasitic, which includes the pathogens. get their food from a living host; and autotrophs which produce their own food.

Commensal (commensalism) - a simple type of interaction in which one organism benefits and the other is not harmed.

Escherichia coli- rod shaped bacteria 0.5 microns in diameter and 1.0 to 3.0 microns in length. May occur singly, in pairs and in short chains. Found in the large intestines of man and other animals. Assist the host in the breakdown of waste products of digestion.

pathogenic organism - a disease causing organism.

Winkler Method - a chemical procedure for determining the dissolved (DO) concentration in water.

ACTIVITY 18:

Background: The students should have some knowledge of E. Coli as an indicator of human waste. They should also have background in safe microbiology techniques. Group size should be about two to four students.

MATERIALS

filtering apparatus
millipore filter
millipore nutrient pad
magnifying glass
vacuum cleaner
Petri dish
eye dropper
measuring cup

Have students collect approximately 100cc. of a water sample from a suspected source. Give them the following directions to find if E Coli is present:

A. Measure out 25 cc of the sample and filter it through the filtering apparatus (use vacuum cleaner for suction). Remove the filter.

B. Place a nutrient pad with 2 cc of sterilized water (or tap water) in a sterile petri dish and put the filter on top.

C. Seal the petri dish and place it in a warm place (80° F) for several days. Observe the results.

The students may attempt to do actual count of coliform colonies. The students may want to expand this activity to other streams or water sources in the area.

AIR

Background: Ozone and nitrogen oxides are closely related in air pollution mainly because as amounts of oxides of nitrogen increase, the amount of ozone increases. The relationship can be seen in the following equations:

NO_2	$\longrightarrow$	NO	+	O
nitrogen dioxide	yields	nitrate oxide	+	oxigen

O	+	O_2	$\longrightarrow$	O_3
oxygen	+	oxygen	yields	ozone gas

Nitrogen oxide, mostly dioxide (NO_2) and nitric oxide (NO_3) are discharged into the atmosphere from motor vehicles at the rate of about 6 million tons per year. Industry contributes 2 tons each year. Nitrogen dioxide is a brownish gas at room temperature and is soluble in water. When it dissolves in water, it forms nitric acid and nitrous acid.

$2NO_2$	+	H_2O	$\longrightarrow$	HNO_3	+	HNO_2
nitrogen dioxide	+	water	yields	nitric acid	+	nitrous acid

Ozone is formed when a single atom of oxygen combines with oxygen gas. This reaction takes place in the presence of sunlight and hydrocarbons. The combination of ozone, nitrogen oxides, hydrocarbons and sunlight produce a photochemical smog. This condition occurs in areas where there are many industries and automobiles,where the population is dense, where the climate is warm, and where there is poor ventilation, as within a valley.

Although one cannot look up into the sky and identify specific pollutants as being ozone or nitrogen oxides, there are definite signs that point to the possibility of their presence. Sometimes after a spring electrical storm, you can detect a faint odor of garlic. This is an indication that there may be increased amounts of ozone. This odor may also be detected when sun lamps or ultra violet lamps (U.V.) are used because U.V. lamps produce O_3. The appearance too, of smog on a warm summer day may be evidence of these photochemical pollutants. If you make a study of the objects and organisms around you, such as the plants, rubber products or synthetic fabrics, you may see them change over a period of time. For instance, pollution can retard the growth of plants ot stop it altogether. Ozone, in particular causes rubber products to deteriorate, and oxides of nitrogen will cause synthetic fabrics such as nylon stockings to disintegrate, especially if nitric or nitrous acids are formed.

ACTIVITY 1:

MATERIALS (per student)

- empty coffee cans
- rubber bands
- can opener (Church key type)
- ultraviolet lamp
- large heavy cardboard box or wooden box

Construct Ozone Detectors. At the open end of an empty coffee can make two holes on opposite sides with a can opener.

Stretch a rubber band across the opening and attach on the ends of the turned up metal. Secure the rubber band by bending the metal over it. (Figure 1)

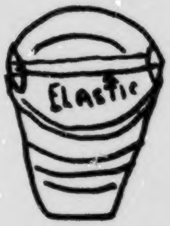


Figure 1

Place the ozone detectors in various areas around the school, community and home. Be certain to place some near electric motors because the electric charges produce ozone.

Check your ozone detectors each day and look for cracking and deterioration of the rubber. Record your observations. Where do you find most evidence for the presence of O_3?

As a standard of reference, set up a chamber with an ozone detector in it and an ultraviolet lamp (sun lamp). The chamber can be a large cardboard or wooden box. If there is a fume hood available, use it instead of the box. Face the lamp away from the window so it won't shine in anyone's eyes. U.V. radiation can damage the retina.

Shine the U.V. lamp on the rubber band. Check it each day and record your observations. Is deterioration inversely proportional to or directly proportional to the amount of U.V. exposure? How does your controlled sample compare to the samples you tested in the field?

ACTIVITY 2:

MATERIALS (per student)

- empty coffee cans
- old nylon stockings and other synthetic fabrics
- strong tape
- twine

Wrap a piece of nylon stocking around the open end of a coffee can and do the same with the other synthetic fabrics. Tape the fabric to the can. To be certain the fabric is secure, tie a piece of twine around it too. You now have a nitrogen oxide detector. (Figure 2)

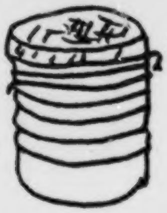


Figure 2

Make several nitrogen oxide detectors and place them in various areas around the school, in the community and around the home. Be sure to locate some where you can reasonably guess you will find oxides of nitrogen. Code them so you will know where you located a particular fabric.

Check your nitrogen oxide detectors every week for three months. Record your observations.

After three months, collect all your nitrogen oxide detectors. Code them so you will know where they were located. Record your observations.

ACTIVITY 3:

MATERIALS (Per student or team of 2 or 3 students)

Natural fabrics: Cotton, wool, silk
Synthetic fabrics: rayon, orlon, nylon
Nitrogen oxide detectors

Prepare several nitrogen oxide detectors as described in Activity 2 with the pieces of material listed above.

Select a location where you know there is contamination by nitrogen oxides. An area should have been identified in Activity 2. Place the nitrogen oxide detectors in that location. Be sure you have one or more of the following combinations: cotton and rayon, wool and orlon, or silk and nylon.

Observe and record your observations each week for three months. Which fabric began to deteriorate first? The fastest? Last? Slowest?

After three months, collect all the samples and examine under a stereoscope and a compound microscope. How do the synthetic fibers compare to the natural fibers? Are the natural or the synthetic fabrics more durable? What are some of the other factors that may have influenced your results?

ACTIVITY 4:

MATERIALS

cans or jars
sticky paper
compass and/or map

Have students wrap the sticky paper around the cans and set them outside for a week in the school yard, in students' backyards, etc. Be sure the wind can strike the cans from all directions. Have groups keep a chart of wind directions for the seven day period.

At the end of the week, let students examine the particles collected on the sticky surface and make a record of their size and number. Using these observations and their wind direction chart, students can trace the particles to their source.

The activity can be repeated during the year to see if more particulates are evident during different seasons.

ACTIVITY 5:

MATERIALS

- large jar
- small jar
- cheese cloth
- petroleum jelly
- microscope slides and cover slips
- microscope
- probe or toothpick
- elastic bands or thread

In this experiment students will collect solid particles from the air. They will compare their results with the other members of the class and try to determine if location had an effect on the results.

Have each student obtain two jars, one smaller than the other. Stretch cheese cloth across the top of the smaller jar and smear it with petroleum jelly. Place the smaller jar inside the larger one and place the jars in an outside area (a different one for each student such as along the side of the road, backyard, roof, wooded area, or near a factory) for three or four days.

Give studets the following directions and questions:

Describe your collection site (include weather conditions).

Write a description and/or make a drawing of the cheese cloth after the four day exposure.

Using a probe or toothpick place a thin smear of the jelly from a dark area of the cheese cloth on a microscope slide. Observe and describe the size of the particles.

Place the cover slip on the slide and look at the slide under the microscope. Write down your observations.

Compare your results with other members of the class.

Why did you place one of the jars inside of the other at the beginning of this experiment?

Do your observations give you any ideas as to why people are worried about pollution?

Repeat the activity during the year to see if there is a difference in types and amounts of particulates collected.

NOISE

Background: Some people are wild about rock and roll music, boogie-woogie and jazz. To others, this kind of music is nothing but noise and can be terribly irritating to the listener. The sound of a fog horn coming in over the ocean can be soothing and restful. To others, it can elicit fear and concern for loved ones at sea. The roar of a roller coaster can be exciting and terrifying at the same time. Birds singing in the morning can be a pleasant welcome to a new day while to the person who wants to sleep, it can be noise. So we see that depending upon our experiences and likes and dislikes, sounds can be classified as noise and at other times as something pleasant, or even, music.

When we refer to noise as an environmental pollutant, noise is defined as sound so loud it can cause deafness and illness. Noise level is measured in units called decibels. The threshold of pain has been placed at between 130 and 150 decibels. Hearing loss can occur as a result of continuous exposure to sound levels of 85 decibels and above. Today's teenagers have poor hearing mainly because they believe their stereo sets must be played at high volume though many of the musical groups already exceed the safe sound level when they use amplifiers. Many men and women working in offices and factories also suffer from loss of hearing when exposed to continuous excessive noises.

We are constantly aware of noise around us and many of us seek refuge away from the hubbub of the city, from the noise of cars and trucks, the squeal of brakes, the honking of horns, the shrill sound of the ambulance or police car siren, the whine of a fire engine, the pounding of typewriters, the pounding of a jackhammer, and the roar of machines in a factory or a jet aircraft. Everyone needs peace and quiet, a time to think, a time to listen to one's inner self and nature. Don't forget that your students too, need time to think and to listen.

According to the American Association for the Advancement of Science, noise pollution causes much more than deafness. It can cause people to become nervous and tense, irritable and frustrated. When noise interferes with sleep, some individuals have developed ulcers or high blood pressure, and the loss of peace of mind has brought on heart attacks. As blood vessels constrict, researchers have found that higher cholesterol levels result. Noise can cause seizures in epileptics, and it affects autonomic nervous system which controls the heart, blood vessels, muscles, and glands. Research on rats reveal that noise can trigger the production of hormones that cause the amount of salt and water in their bodies to increase, making them ill. Additionally, it has been found that a pregnant woman produces hormones under stress of noise that can affect the unborn child adversely. The unborn fetus also responds to outside noises and again, experiments on rats reveal that such offspring learn more slowly and are often emotionally unstable.

Thus, we see that noise is not only annoying but also dangerous. To explore the level of sound you and your students are exposed to each day, conduct the following activity.

ACTIVITY 1:

MATERIALS (per class)

- decibel meter or tape recorder
- chart paper
- graph paper
- meter stick
- notebook and pencil

Measure the size of your classroom. Record in your notebook. Make a list of everything in your room, e.g., the number and size of the windows, the shades, bulletin boards, chalkboards, desks, chairs, benches, etc.

Describe the room and the materials which make up the floor, walls, ceiling, furniture, etc. Do you have a rug on the floor? Are the walls plaster? Is the ceiling made of acoustical material? Is the furniture plastic, metal, wood? Are there shades and drapes at the windows?

Obtain a decibel meter from the music, maintenance, speech and hearing, or science departments. (They cost about $40.00.) If none is available use a tape recorder and record the levels registered on the intensity gauge. Leave the volume on normal.

Using the decibel meter (or tape recorder) record the noise level in the classroom during various activities such as during the class discussions, independent study or laboratory work. Do this for one week and record on a large chart. At the end of the week, plot the number of decibels on graph paper for each activity.

When is the class the noisiest? What is the decibel range in your room from lowest to highest? How can you cut down on the noise? What changes can or should you make in the room?

Repeat the above with other rooms in the school and compare the graphs. What room is the noisiest in the school? When is it noisiest in the halls?

Prepare a report based on your investigations and present a copy to the Principal, the Superintendent, and to the Chairman of the Board of Education. Be sure to include specific date and recommendations for improvement.

ACTIVITY 2:

Background: Sound is measured in decibels. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect.

Decibels are not linear units like miles or pounds. Rather, they are repsesentative points on a sharply rising curve. Thus, while 10 decibels is 10 times more intense than one decibel, 20 decibels is 100 times more intense (10 x 10), 30 decibels is 1,000 times more intense (10 x 10 x 10) and so on. One hundred decibels, therefore, is 10 billion times as intense (that is, represents 10 billion times as much acoustic energy) as one decibel. The reason for such a complicated scale is simply that the human ear detects a wide range of acoustic energy.

Sound levels are measured at their source; thus their decibel rating decreases as the distance from that source increases. These ratings should, therefore, be regarded as averages and should be used primarily for comparative purposes.

The gently rustle of leaves, for example, is rated at 10 decibels, while a typical office has about 50 decibels of background noise. Moderate traffic noise ranges around 70 decibels; a police whistle hits 80. Subways and elevated trains rank just below thunder at 100 decibels. At just about 120 decibels the ear begins to feel pain.

Sounds are heard because cilia in the cochlea of the inner ear vibrate. Loud sounds damage the nerve endings to each cilia causing it not to vibrate (each vibrates at a specific frequency). Students hearing much loud music often have hearing loss at high frequencies due to damaged nerves. They may also have blank spots where only certain frequencies have been damaged.

MATERIALS

- Audiometer
- Tuning forks

Divide the class into two groups - those who listen to loud rock music and those listening to classical or semi-pop. Test the hearing of both groups by having students raise hands as long as they hear the signal being generated by the audiometer.

As hands go down tell each student at what frequency he stopped hearing the sound and have him record that information.

Have the students compare the range of hearing of students from both groups. If differences are not observed, lead students into a discussion of variables such as length of time spent listening to loud music, sample size, and actual loudness of the music.

Students can study the effect of continuous sound on humans by generating a sound for 3 - 10 minutes. Pupils of eyes can be measured by increasing distances. The closer a student is to the sound, the more dialated the pupil should be.

Demonstrate sympathetic vibration (as in cilia of cochlea) with two tuning forks on same frequency. Students may check effect of age on hearing by testing young to old persons. Range of hearing tends to decrease with age.

Decibel Chart

	Noise Level Estimation			
	Noise Level	Response	Hearing Effects	Conversational Relationships
Liftoff of a Saturn V Rocket	167			
	150			
Carrier Deck Jet Operation	140			
	130	Painfully Loud Limit Amplified		
Jet Takeoff (200 feet)	120	Speech		
Discotheque, Auto Horn (3 feet) Riveting Machine	110	Maximum Vocal Effort		
Jet Takeoff (2,000 feet) Garbage Truck	100			Shouting in ear
N.Y. Subway Station Heavy Truck (50 feet)	90	Very Annoying Hearing Damage		Shouting at 2 feet
Pneumatic Drill (50 feet) Alarm Clock	80	8 hours Annoying		Very loud converstaion, 2ft.
Freight Train (50 feet) Freeway Traffic	70	Telephone use		Loud conversation, 2 ft
(50 feet) Air Conditioning Unit (20 feet)	60	Difficult Intrusive		Loud conversation, 4 ft.
Light Auto Traffic (100 feet)	50	Quiet		Normal conversation, 12 ft
Living Room Bedroom	40			
Library Soft Whisper (15 feet)	30	Very Quiet		
Broadcasting Studio	20			
	10	Just Audible		
	0	Threshold of Hearing		

SOLID WASTE

Background: Solid waste disposal has been a problem since ancient times, only years ago, there was more space to throw things away. Today the problem is made worse by increased populations, by crowding in the cities, and by the fact that, as former Governor William T. Cahill of New Jersey has said, there just is no "away" any more. Wherever there are people, there is going to be litter and garbage. When people had room to spread out, and when the majority of people were farmers, they returned to the land what they took from it. Composting was a part of their daily routine. Animal and household wastes were buried in the ground where they would decay, allowing the raw materials to return to the soil to be recirculated through the biological system. It was good for the crops, and it was a means of getting rid of unwanted rubbish.

Our current problem is compounded because we have so many more things to discard and our whole way of life has changed. At one time, it was a sign of thrift if one took care of material things and repaired them when needed. Now-a-days, we manufacture products for obsolescence. When they break down, we throw them out. Gone are the days when your refrigerator would last thirty years as have some of the old monitor top models. Gone are the days when you could expect a bicycle to last a child through all of his growing years.

It apparently is cheaper to discard than to repair. It is better for the economy if we keep money circulating even if some people have to take out loans to buy a new stove.

In 1970, the United States produced 4 billion tons of solid wastes which amounted to about 5 pounds (2.25 kilograms) per person. It has been estimated that by 1980 the amount will increase to 8 or 8 1/2 pounds (3.6 kilograms) per person. In one year, we easily discard 7 million autos, 26 billion bottles, 48 billion cans, 15 million tons of glass, and 35 million tons of wood fiber.

Unfortunately, when we discard, our means of disposal damage the environment. Open dumps are unsightly, smelly, and breeding grounds of rodents and cockroaches - both potential disease carriers. Even sanitary land fills leave much to be desired, though the garbage is covered with soil and eventually, the dump can be completely filled and converted to a recreational area. Regardless of which kind of land disposal is used, the environment is altered and the natural area is destroyed. Too often waste disposal facilities are located on the shore of a lake or in a marsh. The rubbish is usually carried into the water by the wind and the liquid waste leaches into the water contaminating it with undesirable solid, chemical and bacteria wastes. Moreover, the land or marsh is destroyed, never to be regained.

Incineration is another method of solid waste disposal. This method also alters the environment because the waste gases and particles pollute the air. Efforts are being made, however, to improve this method. Another disadvantage to incineration is that when materials are burned, the raw materials go off as smoke and are not returned to the soil. Dumps do provide the chance for some things to decay and return important materials to the land.

Much of what is manufactured today is not biodegradable - that is, it will not decay or rust with time. Animal wastes, dead plants and animals, wood, paper, cardboard, tin cans, and so on will break down. Most plastics, tires, and aluminum cans do not break down at all or they take a very long time to do so. Plastic garbage bags are used more and more, and although they reduce the cost of collection, they add to the waste problem. Recently, though, plastic garbage bags have been developed that will burn and change into carbon dioxide and water rather than into poisonous gases as is the case with the other plastics.

Try to impress upon your students that litter and garbage are aesthetically undesirable and that garbage, if not disposed of properly, can be dangerous to their health.

ACTIVITY 1:

MATERIALS (per student)

pencil and paper

Make a chart and list the materials you think you would be throwing away. Categorize them into large groups: paper, metal, plastic, wood, glass, ceramic, cloth, food, other.

Each day, tally the number of materials you discard in each category. Add up the total number of materials you discard each day.

What kinds of solid wastes do you discard? What solid waste do you discard most often? What happens to the waste materials after you discard them?

ACTIVITY 2:

MATERIALS (per student)

average size garbage can
spring scale or bathroom scale

Weigh a clean empty garbage can either on a bathroom scale, or tie twine on each handle and attach the twine to a spring scale. Record.

Fill the can with waste as you normally would. Weigh the can again full of garbage to obtain the weight of the garbage. Record.

Check to see when the garbage is collected on your street or block and count the number of cans that are put out to be emptied. Record.

ACTIVITY 3:

MATERIALS

1 bathroom scale
1 or 2 large plastic garbage bags

For a period of one week, do not use the trash can in your class for waste paper, simple have the students throw all used paper on the floor of the classroom. If you have solid waste material other than paper, put it into the trash can, but do not throw it out until the end of the week. Ask your school janitor not to sweep the floor of your classroom for a week. You are going to make a big mess, so you will have to clean up the room after the experiment is over.

At the end of the week, gather up all of the solid waste and put it into plastic garbage bags. You can weigh each bag by doing this: Have one person stand on the scale without the bag of solid waste. Record that person's weight. Now have him stand on the scale again, this time holding a bag of garbage. Subtract his weight from the total weight and you will have the weight of the bag of solid waste. Do this for each bag and also for the things you put into the garbage can. Enter the figures in the data sheet on page ____.

Now have the students figure out how much solid waste would be produced by the class in a school year if it produced a similar amount every week for the 36 school weeks. Add up the number of students in the participating classes and calculate the average amount that each student would produce during one school year. Calculate how much waste would be produced by your entire school in one school year (multiply the average amount by total number of students in school). If you can find out the number of students in your school system, you can figure out the amounts of solid waste produced in one school year.

Discuss the following questions with your students:

1) How did it feel to have this waste material lying around in the classroom for the week?

2) Did your feelings about the room change over the week-long period?

3) Were you surprised at the amount of solid waste you produced?

If you divided the total amount by the number of students in the class, you would get the amount of waste produced by each person. This figure, divided by the number of days the experiment went on, would give you a per person, daily rate. How close was this to the national average of from four to six pounds? If it is less, can you suggest some reasons why?

4) How could you present the results of your study to other classes or to parents so that they could appreciate the size of the problem?

5) Would the local newspaper be interested in printing a story about what you have done? You might invite a reporter to your class the day you collect all the waste material and weigh it.

Take pictures of your class, have students write an article for newspaper.

6) What will happen to all of the solid waste you have produced? Where will it go and how will it be disposed of? Will it be burned, buried, or what? Find out what the city sanitation department does with this type of waste. How do the workers get rid of it so that it doesn't create another pollution problem? If, for example, they burn solid waste, how do they avoid making a lot of smoke, which contributes to air pollution? Perhaps the city engineer in charge of waste disposal

would agree to talk to your class about these and other problems your community may be facing. Make suggestions as to what can be done to reduce this amount of solid waste.

In class discussions bring in the slum areas and how the attitudes of people who live in the slums are affected by the environment in which they live. Students can take pictures of solid wastes that are left on sides of the road, old junk cars that are dumped, etc.

Data Sheet

One Year of Trash

1. Total number of pounds of trash produced in one week ____________
2. Total number of weeks in one school year (36 weeks) ____________
3. Total number of pounds produced in one school year ____________
4. Total number of students participating the experiment ____________
5. Divide #4 into #5 to get average per student per school year ____________
6. Multiply #5 by the total number of students in your school ____________
7. Multiply #5 by the total number of students in your county ____________

ACTIVITY 4:

Assembling a talking litter basket reminds people not to litter.

MATERIALS

- a piece of plywood (or poster board)
- speaker
- speaker wire
- speaker jack (male)
- tape recorder with microphone
- trash can

Have students design and decorate a plywood or poster board cutout of a man (or woman). Attach the speaker to the rear of the figure. The speaker should be wired and jacked into the external speaker hole in the tape recorder or public address system.

Without using tape, turn the recorder to "Record" and turn the monitor switch to "On." Turn up the volume and talk through the microphone. Place the "talking figure" behind a large trash can outside your school window or on the street or playground. Your students can now be the voice of the "Talking Litter Basket." Students can conceal themselves near windows. Allow them to practice dialogues and songs.

Follow-Up:

If the project is successful, let your local TV station and newspaper know about it.

If you would like to see how a talking litter basket works, write for the free loan film The Litter Monster, available from:

Keep America Beautiful
99 Park Avenue
New York, N.Y. 10016

ACTIVITY 5:

To determine what solid wastes are and how they are disposed of:

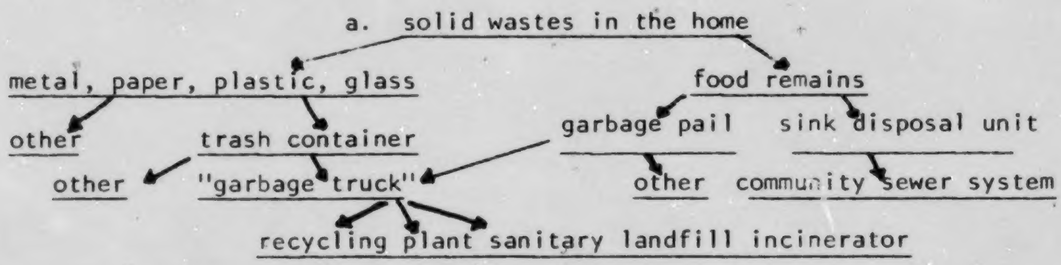
Have students keep careful records on the amount and kinds of solid materials they dispose of during normal living activities. For example:

a. food wrappers
b. boxes
c. cans
d. bottles
e. food remains

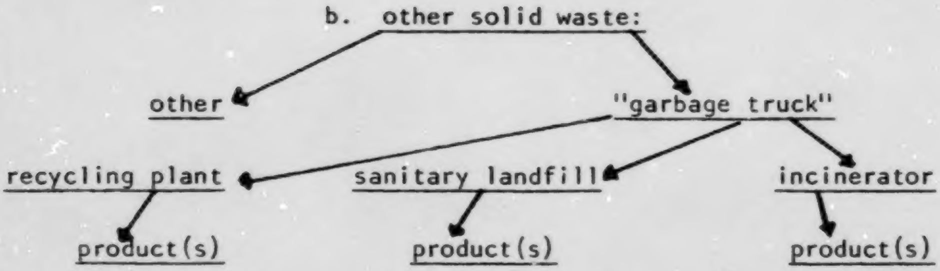
Have students make a survey of the community to identify solid wastes other than those indicated above. For example:

a. "junk" automobiles
b. rubble from demolished buildings
c. highway litter
d. fallen leaves
e. dead trees
f. lawn clippings

Trace the disposal pattern of solid wastes originating in different locations in the community. For example:



b. other solid waste:



Have students design and label flow charts similar to above charts as biodegradable solid waste and non-biodegradable solid waste.

Have students form teams to visit sanitary landfills to observe the operation and to interview local officials associated with the facility in order to collect such information as:

a. the basic requirements for the siting and operation of the landfill - for example:

   (1) suitable topography
   (2) availability of "fill" material
   (3) earth-moving equipment
   (4) access roads

b. the successive annual rates at which the site is being filled

c. the problems in acquiring sanitary landfill sites - for example:

   (1) cost of land
   (2) reaction of people living near proposed sites
   (3) topographic considerations
   (4) distance of proposed sites from the community

d. the potentially useful materials that become inaccessible when deposited in a sanitary landfill. (e.g., glass, paper, and metal)

Have the students discuss their findings and draw tentative conclusions from the information gathered in the previous activities - for example:

a. define the term solid wastes in terms of:

   (1) the materials of which it is composed
   (2) use patterns of people
   (3) the destiny of the materials

b. the ways in which materials identified as wastes might be considered useful. For example:

   (1) feeding food remains to animals
   (2) reusing boxes for other purposes
   (3) using building rubble for road building
   (4) using leaves and lawn clippings in compost heaps

c. ways the volume of solid wastes deposited in local sanitary landfills can be reduced. For example:

(1) sorting solid wastes to isolate recyclable materials
(2) reusing materials usually discarded after one use
(3) use of home waste compactors

d. Have students determine why the siting and operation of sanitary landfills is considered to be a problem. For example:

(1) population growth in communities has led to more people producing more wastes
(2) there has been a trend toward the creation of throw-away items for household consumption
(3) increased affluence coupled with low-cost, mass-produced items has led to easy replacement of items and less concern for saving and reusing them
(4) community growth and increased land values have made it difficult to acquire landfill sites close to the community
(5) increased demand on landfill sites has decreased the half-life of land fills

ACTIVITY 6:

MATERIALS (per student)

pencil and paper

Make a chart and list the materials you think you would be throwing away. Categorize them into large groups: paper, metal, plastic, wood, glass, ceramic, cloth, food, other.

Each day, tally the number of materials you discard in each category. Add up the total number of materials you discard each day.

What kinds of solid wastes do you discard? What solid waste do you discard most often? What happens to the waste materials after you discard them?

ACTIVITY 7:

MATERIALS (per team of 2 or 3 students)

balance or scale
Bunsen burner, stove or hot plate
tripod
covered porcelain crucible or pan
clay triangle
tongs
various solid waste materials: metal, paper, plastic, wood, glass, ceramic, cloth, food, etc.

Set up your apparatus. Place the triangle on the tripod and the crucible in it, or place a pan on a hot plate or stove.

Cut up one of the materials, weigh it, and place it in the crucible or pan. Cover. Apply heat to the bottom. Is there smoke? Is your material turning black? Is ash forming? Does the material catch fire? Record your observations.

Let the material cool and weigh it again. Record. What do you conclude?

Repeat the above with each one of the materials. What materials can be burned without causing too much damage, and which materials should perhaps be buried?

ACTIVITY 8:

Determining which solid wastes are biodegradable.

MATERIALS (per class)

- balance or scale
- magnifying glass
- several large seedling flats filled with soil
- watering can
- various solid waste materials: metal, paper, plastic, wood, glass ceramic, cloth, food, etc.
- several sticks and labels

Select a variety of materials and weigh each one separately. Record. Bury the materials under the soil in the school yard or in seedling flats and label them.

Sprinkle the soil once or twice a week to simulate rain if the materials are left indoors.

After several weeks, remove them one by one and examine each material carefully with a magnifying glass. What do you observe? Is there any evidence of decay?

Gently clean off the soil. Weigh each material and record the weights. Have the objects gained or lost weight? Have they stayed the same? How would you interpret your results?

Return the materials to the soil and check again in another few weeks.

ACTIVITY 9:

To determine how solid wastes affect people.

Have students form teams to interview appropriate representatives of community agencies to determine:

a. the number of people employed by the community in activities associated with solid waste disposal

b. the percentage of solid waste that might be recovered if a recycling plant were operating in the community

c. financial benefits of a recycling plant (i.e., profits from sale of retrieved material - capital investment in recycling plant depreciated over estimated life of plant - operating costs)

d. people's reactions to the aesthetic properties of sanitary pollution in the community

e. extent "garbage trucks" contribute to air pollution in the community

Have students form teams to conduct a survey of determine how many people believe:

a. current methods of disposing of solid wastes are acceptable

b. new procedures are needed for disposing of solid wastes

Have the students discuss the following questions:

a. Who bears the greatest responsibility for the problems associated with solid waste production and disposal?

   (1) the consumer
   (2) the packaging industry
   (3) local governmental agencies
   (4) science and technology

b. Which of the following practices should be adopted? Why, or why not?

   (1) using only returnable containers
   (2) buying only the largest quantity of a product that is available
   (3) washing and reusing containers rather than disposing of them
   (4) taking your own shopping bag to the supermarket to avoid the need for paper bags supplied by the market

ACTIVITY 10:

To determine how solid wastes affect people.

Have the students determine if it takes more packaging material to package a quantity of material in two or more packages than it takes to package the same volume of material in one package.

Have the students determine whether:

a. people purchase materials in the largest volume package

b. there are savings in purchasing the large economy size

Have the students determine how it would affect the community of a law banning the sale of beverages in disposable containers were to be passed in their community. For example:

a. interview representatives of local bottlers, wholesalers, and retailers of beverages to determine their reaction to such a law

b. determine the number of bottles and cans of soft drinks sold in the community in an average month

c. determine the average monthly number of reusable containers that would have to be returned

d. determine the number of reusable containers to be returned by each individual each month

e. interview people to determine their attitudes toward reusable soft drink containers

Milk used to be sold in reusable glass containers. Have students determine the affects of restoring this practice on:

a. the volume of solid wastes produced by the community

b. the use of drinking water for cleaning the milk bottles

c. the milk packaging industry

Have students identify ways he may reduce the amount of biodegradable material picked up from his home.

ACTIVITY 11:

Background: The process of recycling occurs in nature. Metabolic wastes in biological systems, as in a food web, are returned to the soil for plants to use again. Water is recycled. It evaporates and falls again to the land as rain or snow. Doesn't it seem sensible then, to reuse man-made wastes? The reprocessing of waste materials for reuse is also called recycling. These waste materials that can be recycled are plastics, metals, paper and glass. Other wastes that are more difficult to dispose of and just as difficult to recycle are old tires and pesticides.

We are not too concerned about wet garbage, such as food scraps and wet paper, because these materials are biodegradable and decomposers will eventually break them down in sanitary landfills. We are concerned though about the raw materials leaching into the dump area and being lost to a viable ecosystem. By composting these materials in a corner of one's backyard, these raw materials will be recycled through the food chains and webs.

Plastics pose another problem because most of them are not biodegradable and will persist in the environment. Neither can they be burned safely due to the poisonous gases produced. Some of them when burned produce corrosive hydrochloric acid and thus pollute the air. The majority of plastics don't burn at all but melt instead, and foul the grates of the incinerators. Plastics are flooding the market in the form of packaging material in plastic. We have plastic cups, plastic bags, plastic wrap, plastic containers, plastic trays, and so on. Recently, researchers have found that the polyvinyl chloride (PVC) plastic containers slowly leach plasticizer into protein substances - that is, substances such as meat, or blood in blood banks absorb the plasticizer from the plastic container. Evidence of accumulated quantities have been found in the liver, spleen, lungs, and abdominal fat of patients transfused with blood stored in these plastic bags.

Two ways to recycle plastics would be: first, to develop more plastics that are biodegradable; and second, to remold used plastics into something new. If all milk containers, for example, were made of the same type of plastic, they could be collected together and remolded. As it is now, there are many types of plastics being used and a general collection of all would make the separation, washing, and grinding too expensive. The

The scientists have more work to do in this area.

Although metals make up only a small percentage of the mass of solid wastes, they still present a problem for disposal and recycling. Regardless, they must be recycled because metals are natural resources of fixed amounts, and it is estimated that within 50 years we will have used up our tin and zinc unless they are reclaimed after use. Junk automobiles present the greatest problem. It is difficult to separate the various materials of which a car is made. Cars are made of ferrous (iron) metals, copper, chrome, plastic, glass, fabric, and rubber. Steel mills and foundries make use of 6% of junk autos for the iron content but much of the other material is not reclaimed. It is still a costly process to compact, shred, and separate the materials to make them available for reuse. Additional problems arise when one considers the fluctuating scrap supply and demand, transportation costs, and changing steel production technology.

Tires present a problem all their own. They do not disintegrate in sanitary landfills and always manage to rise to the top when compaction is attempted. They cannot be incinerated because they pollute the air, nor can they be recycled. Tires are not just made of natural or synthetic rubber, but plastic, nylon and steel. Trying to separate them into their parts would be a difficult and expensive task. Some hope for the use of old tires has been envisioned though, by the Bureau of Solid Waste Management and the Fish and Wildlife Service. These federal departments have investigated the possibility of using the tires to establish artificial reefs and fish havens along the Atlantic coast. Tires are set in sandy areas to provide sea life with some protection and spawning grounds. If continued success is realised, many useless tires could be turned into beneficial functional devices.

Beverage containers, of which cans are a part, comprise 3.9% of refuse collected, and this amount is increqsing. Cans of food goods and beverages are made of steel and tin alloy or of aluminum. If the steel could be extracted, it would sell as scrap metal for about $20.00 per ton. The tin would eventually rust but, as stated before, it should be reclaimed since the United States has already used more than one quarter of its total mineral supply. Aluminum does not readily disintegrate and should be reclaimed and recycled. Some companies have paid 10¢ per pound (453 grams) for used aluminum.

Our greatest waste material is paper but fortunately, paper and paper products are biodegradable. Paper can also be easily recycled and used again as boxes, cartons and stationery. Obviously, trees are sacrificed to make paper, and although trees can be replanted, by recycling 1 ton of paper, seventeen trees can be saved. As it is, Americans consume 430 pounds or 195.5 kilograms of paper yearly. Of this amount only approximately 19% is actually recycled. The rest finds its way to the incinerator to pollute the air, to the dump, or is left on the roadsides and at beaches and parks as litter.

Glass is nonbiodegradable but can be ground up and used as filler insulation, and in road-building material. The problem in recycling it is in collecting and removing plastic and metal parts from the glass, and in separating it by colors. The returnable bottle, apparently for economic reasons, is a thing of the past. It is cheaper to make new glass bottles than to retrieve, wash, and refill old ones.

In some cases, there is evidence that recycling is beneficial and indeed, sometimes necessary if we are to continue to have certain materials. In other cases, the cost is prohibitive or the technology for recycling has not been perfected to make the reprocessing profitable. Some states, such as Connecticut, have devised a long term plan to recover resources and authorities claim that recycling can be practical, feasible and economically advantageous. Dan W. Lufkin, former Connecticut State Commissioner of the Department of Environmental Protection, and his committee have suggested that much can be gained of the total community cooperates in the fight against the solid waste crises. In a state-wide system, they propose there should be centers for collection, separation, materials recovery, and processing. These centers should be located according to population density so that people would be living within one waste shed or another and their refuse would be sent to the collection center within their own waste shed. With the approach and long range planning and projections, economic benefits, recovery of our resources and overall environmental improvement should result.

Perhaps your students would like to become involved in some recycling activities. What is your school doing now? What is your community doing about the solid waste crises and recycling? Has your state of district made any effort to encourage recycling? Provide opportunities for your students to investigate the status of recycling in your area. Perhaps they may feel a need to join a community action group or to start a recycling drive or center of their own. Find out which manufacturers or businesses in your area are willing to cooperate. Have the students contact a local group of organic farmers to discuss the advantages of organic gardening and composting. As an outgrowth, the student might want to try the following activities.

MATERIALS (per class)

small plot of land 1.86 meters x 1.86 meters or
large refuse bin
references on composting

Select an obscure section of the school yard away from the building for a site for a compost pile. Read about composting and contact resource people in the area to learn more about the advantages of composting and how to build a compost pile.

Select a team of 2 or 3 students to present your proposal to build a compost pile in the school yard to the principal of the school. If the principal grants you permission, work out the details on separating and collecting the food wastes with the person in charge of the cafeteria.

Stake out and fence off the dumping area and erect a sign in front of it so no one will disturb the plot. If you prefer, use a large refuse container instead of dumping on the ground.

Send another delegation to speak to the maintenance department and arrange to have them dump grass cuttings and brush trimmings into the compost pile. (Addition of animal wastes, due to their high nitrogen content, will speed up the decomposing process too.)

Each day, dump the food wastes onto the pile until you have filled the designated area. Stir once a month with a shovel or long pole. Observe what happens to your compost each month. Describe the changes that have taken place. It will take from three to six months for your compost to decompose into a rich, natural fertilizer. How long does your compost pile take to decompose?

When your compost has broken down, take some of the runoff water from it and water 2 or 3 plants. Take 2 or 3 more identical plants and water them with ordinary water. Do you see a difference? Explain your results. Do you think composting is worthwhile?

Contact your local Organic Garden Association or write to your state or national association. Learn how to garden the organic way and use your decomposed compost accordingly. If you wish, write to Educational Services Division, Rodale Press, Incorporated, Emmaus, Pennsylvania 18049 for more information on organic gardening.

POPULATION

Background: In 1830, there were 1 billion people in the world. In 1970, the number has risen to 3.5 billion. By 2000, there will be 7 billion persons, and an estimated 14 billion has been predicted by 2015. The planet earth is reaching its capacity to support life and if it should, what then? Can we escape to another planet and likewise, pollute that too? Is man, in fact, the most endangered species of all and is he irreversibly destined to become extinct because of his own shortsightedness? All the ills of the cities and all our environmental problems are caused by nothing more than too many people in competition for too little food, too few goods, too little space, and unconsciously too, for a limited amount of natural resources of which air and water are of prime importance. The population is growing at a rate of 2% a year and today, more than 1 billion human beings are suffering from malnutrition and undernourishment. How can we possibly keep up with the demand for food with shrinking space and natural resources?

In the United States, every nine seconds a baby is born. It has been calaclated that each child will consume in his lifetime 9 tons of milk, 5 1/2 tons of wheat, 5 1/2 tons of meat, 37 thousand gallons of gasoline, and 56 million gallons of water. Americans consume about half of the world's resources yet comprise only 6% of the world's population. This consumption presents a trememdous drain on our natural resources, and overpopulation threatens the possibility for children to grow up as healthy and contributing human beings.

If we are to preserve the sanctity of life, people must grow up with dignity. Slums, poverty, and starvation have deprived millions of people of human dignity. Research and experience has shown that overcrowded conditions breed frustration, abnormal behavior, and violence, or dullness and indifference. Human beings have the intelligence to control their own destinies and to predict disaster and yet, we are often blind to the realization that we too are a part of the stream of life and must take responsibility for our own actions. We can no longer ignore the fact that what we do does affect the whole. We must realize that the "it-doesn't-apply-to-me-attitude" must be abandoned for the "I-am-responsbile-too" attitude.

Is the picture really all gloom and doom? Will man allow himself to overpopulate to the extent that he will self-destruct? Man's genius has split the atom and sent men to the moon. Man has moved mountains and changed the weather. Does this sound like a species that will destroy itself? On the other hand, man has allowed the environmental problems to build up; he has allowed men to fight one another; he has allowed nations to wage war.

According to some authorities there will be room and food for an increased world population if man approaches the environmental problems sensibly. Education then,as in all things, must play a vital role in bringing knowledge of the truth, of what is good, of what is beautiful and desirable, to the youth of today. We must give them the tools to construct new knowledge and to build on the old. If through education, we can change human behavior and our way of thinking and doing, and if we try to nurture within our youth brotherly love, respect for human dignity, and consideration for the needs and rights of others, man will be sustained.

ACTIVITY 1:

To understand that overcrowding leads to aggressive behavior, divide the class into discussion groups of twos. Hand out a mimeograph copy of the student activity sheet and have the groups discuss the questions.

STUDENT ACTIVITY SHEET

Aggressive Behavior

1. Name as many things as you can think of that make you mad.
    A.
    B.
    C.
    D.
    E.
    F.
    G.
    H.

2. How many of these things that make you mad involve other people?

3. If you and your family suddenly had to move in with other families, would your family live happier with one other family or two other families?

4. If you volunteered to stay in this classroom for 2 weeks, all day and all night, would you rather stay with 0, 1, 5 or 10 other people? Which number group would you least prefer to stay with?

5. List 4 or more reasons for or against living in these groups:

0 Others	1 other	4 others	9 others
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4

6. In which group do you think the most things would happen to make you mad? Why?

7. What would happen at the end of the first week if an additional 10 people were put into the room?

8. If arguments or fights broke out, would you try to stop them? If so, why and if not, why?

9. Do you think it would reach a point where you might like to fight or maybe have to fight to protect yourself?

ACTIVITY 2:

MATERIALS

copy of local Planning Map
copy of Highway Beautification Act (S 2084-Pl 89-285)
copy of the National Land-Use Policy Act (S 3354)

Write to your Congressman and ask for copies of the National Land-Use Act and also ask him to bring you up-to-date on this bill.

Obtain a planning map of your town showing the residential, industrial, commercial, recreational, and open space areas from the Town Plan and Zoning Office.

From your map, determine the total number of acres comprising your town. Then find out what percentage of land is being used by business and industry, and what is used for residents, recreation and open space. What occupies the most land?

If the population were to increase 50% within the next 40 years, where would you put the people? Would it be better to construct single family dwellings or multiple family dwellings? If the population increases, the demand for homes and jobs will also increase. Where and how would you expand the commercial and business areas? If you live on a farm, dairy, or cattle area, what then? Can you follow the recommendations of the National Land-Use Policy Act?

AESTHETICS

Background: Aesthetics represents the mission component in man's impact on his environment; consequently, the environment has changed rapidly fron one of natural beauty to one of alienation and anomie. Which changes in the land over a period of time are inevitably, the effects of man can be guided by an awareness of the power of good design, the human capability of visual valuing, and a sense of order. Man, as well as nature, can create beautiful surroundings.

ACTIVITY 1:

Using the generalization that aesthetic experiences are "those experiences which trigger a sense of beauty in the beholder," have the students prepare a list of subjects which produce aesthetic experiences for them. For example:

a musical selection
a person
a fragrance
a photograph
a painting
a ceramic object
a building
ocean waves
a field of grain
a mountain brook
a city skyline
an airplane in flight
an erupting volcano
smoke billowing from a smokestack
a pond covered with algae

Using photographs, paintings, prints or recordings have the class react to the items contributed by individual students. Try to determine the nature of an aesthetic experience by having the students react to the following.

1. Do most, or all, of the class members agree on the aesthetic impact of these various subjects?
2. If there is disagreement among the class members regarding the aesthetic appeal of these subjects, have the class discuss the basis for their reactions and attempt to explain why there are differences. For example:
    a. Do people who have lived at the seashore react the same way to the sound and sight of breaking waves as people who only occasionally visit the shore?
    b. Do people who have not listened to much classical music react the same way to it as people who have listened to it a great deal?
    c. Does a person's aesthetic sense vary with age? (Students may wish to collect data on the reaction of older and younger students, teachers, parents and compare to the class reactions to the same items.

ACTIVITY 2:

Repeat the procedures in Activity 1, this time collecting examples of subjects which are known to be aesthetically offensive to some. Again solicit responses to each subject, and examine the basic cleanup components of these subjects. Have students try to form generalizations concerning:

beautiful vs offensive colors
beautiful vs offensive textures
beautiful vs offensive shapes
beautiful vs offensive smells
beautiful vs offensive sounds

Discuss the effects of both pleasant and offensive aesthetic experiences on people. How desirable or necessary is it to provide pleasant and aviod offensive aesthetic experiences in one's life? To what extent can an individual control the aesthetic aspects of his environment? Should aesthetic environmental aspects be controlled? Who should make the decision on what aesthetic environmental aspects are to be controlled?

ACTIVITY 3:

Interiew some residents of the community to determine those sights, sounds and smells which they consider to be wither aesthetically pleasing or offensive and draw conclusions based on their findings.

1. Do people living near the center of a community seem to have the same aesthetic values as those living on the outskirts of a community?
2. Is there a relationship between a person's environmental exposure to his aesthetic response to it? For example:
    a. Is a factory worker as disturbed by the sight of heavy, dark-colored smoke billowing from the factory where he works as a non-factory worker?
    b. Is a department of sanitation worker as offended by the sight and smell of garbage as other members of the community might be?
    c. Is a real estate developer as disturbed at the prospect of cutting down a wooded area to build homes as people in the surrounding neighborhood?
    d. Is the head of a construction company as disturbed as other members of the community at the prospect of demolishing a historical landmark to make way for new construction?
    e. Is a rural family deprived of electricity for many years concerned about the location of wires and poles?

ACTIVITY 4:

Have student:

1. Consider items he has purchased in the past to establish a relationship between aesthetic characteristics, cost, convenience, and availability in the decision of his purchases.
2. Determine to what extent this aspect of his environment is controlled by manufacturers to influence his buying patterns.
3. Interview a representative of a manufacturing plant's marketing division to determine the extent to which customer's aesthetic preferences are considered in marketing the product.

ACTIVITY 5:

Have students interview local architects, builders, or developers. Have them:

1. Determine how aesthetic considerations enter the planning and design of buildings and the "trade off" which occurs among aesthetics, costs, availability of construction materials, and building codes in the design of a building.

2. Determine the extent people in the community influence the design decisions made by the architect

3. Discuss their findings and come to some conclusions in terms of any recommendations that might be made to a planning commission.

ACTIVITY 6:

Background: Students should have a working knowledge of the use of a camera. They should have the ability to use photographic processing equipment if available. If not available, commercial processing will be necessary. Students should be familiar with a simple plant key to identify plants in the area. They may work in pairs or teams.

MATERIALS

film
camera
dark room (optional)
plant handbook or key

A walk should be taken with loaded cameras in a wooded area. This may also be done in a backyard or around the school building. During the walk have the students find a plant in good condition and identify it. Then let them take a close-up picture. They may take pictures of one flower or a plant or a specific branch on a tree. They should take a long range as well as a close up picture.

Suggested questions:

1. Do you consider the subjects of your pictures beautiful? If so, why?
2. Are the plants necessary?
3. What would your environment be like without them?

ACTIVITY 7:

Set up an experiment to determine what will happen to plants that are situated on the school campus where there is a heavy traffic flow. Place two groups of plants along a short cut that is frequently used. Place some kind of protective barrier, such as rocks, a fence, etc., around one group and leave the other group unprotected. Take photographs of both groups of plants.

Suggested questions for discussion:

1. Did the barrier protect the plants from students walking through the area?

2. What happened to the plants that had no protection?

3. According to this information, what is the attitude at your school about the environment? Is this attitude widespread or limited to a few students?

Follow up: Take a series of photographs and ask someone else to trace out the route you took.

Using photographs, determine how the area in the picture will look sometime in the future and how it looked some time in the past.

ACTIVITY 8:

Background: Since the greater number of families today are not agricultural, their daily needs for food and work must be supplied by business and industry. There must be grocery stores and restaurants where they can buy food. There must be stores and factories where they can earn a living. With these developments, more and more commercial areas spring up in and around the cities and towns, and competition for customers becomes keener. In order to induce the public to buy one product in preference to another, proprietors advertise. They send out brochures, put ads in the daily newspaper, hang signs in their windows, install neon lights over their doors, and erect billboards along the highways. So it follows that the greater the population, the more businesses and industries will be established, the greater the competition, the more extensive the advertising, and hence, more billboards result.

What do your students think of the billboards? Do they like them? Do they think they detract from the environment or haven't they paid any attention to them? Ask them where they see most of the billboards? Are they along country roads, main highways, or city streets? Why were these locations selected? What are the rulings for advertising in this manner in your locality? Can anyone erect a billboard anywhere he chooses? Have your students perform the following activity to answer some of these questions.

MATERIALS

local and state zoning ordinances for advertising
camera
map of area
notebook and pencil
large sheet
woolen yarn
needle and thread
glue and straight pins
cardboard
marking pens

1. Take a ride or walk around town and photograph each billboard you find. Mark the location on your map. Record the name of the

advertising company that owns the billboard.

2. Compare your information with other teams in your class.

3. Construct a mural representing your local map. Use a sheet for the background and woolen yarn for the streets. Sew the yarn in place. With a marking pen, write the street names on cardboard labels and pin or glue them in place. Glue your photographs of the billboards along the streets where they are actually located on the original map.

4. While some students are working on the mural, a team of 2 or 3 students can visit the town or City Hall and consult with someone in the Town Planning and Zoning Office regarding advertising regulations for billboards. Look up and read the appropriate ordinances.

5. A second team can write to your congressmen and ask for copies of the Highway Beautification Act. Also ask them to bring you up-to-date on the Senate Bill (S1442) authorizing $15 million for pilot programs to remove billboards from highways.

6. Another team can contact the company or companies that own the billboards and ask them how land and permits are obtained for this purpose, and also, how they contact customers. What would happen to them financially if they were no longer allowed to erect billboards?

7. Still another team can call, or better, visit the companies that are advertising on the billboards. Ask them in fact, if they think that this kind of advertising is really profitable. Would they agree to not advertise in this manner if all the other companies likewise agreed?

8. Gather all the information together and discuss it with the whole class. Should billboards remain or be removed? Are the advertisers complying with local zoning ordinances? Are they detracting from the beauty of the area? What are the economic implications if all billboards were to be removed? What Federal legislation is now in force? What action, if any, can or should be taken by the class?

CHEMICAL POLLUTANTS

Background: Since Rachel Carson's book, Silent Spring, was published in 1962, pesticides and their effects have received much public attention. Of all the pesticides, DDT has been given the most notoriety. DDT, or dichlorodiphenyl-trichloroethane, kills all insects whether harmful or not. Obviously, this would be a serious threat to food chains and webs. If, by chance, insects do survive being sprayed by DDT, their offspring are naturally immune to DDT. It has also been found that organisms tend to absorb DDT and pass this concentration of pesticide on to another organism in a higher trophic level. This means that the top predator receives all the DDT absorbed and transferred from the prey below it in a food chain. Scientists have discovered very high concentrations of DDT in eagle eggs, for instances. DDT has been blamed for the inability of birds to lay thick shelled eggs. The shells are so thin that they often break when the mother bird sits on them. It is believed, therefore, that DDT is responsible for the scarcity of the bald eagle and the osprey.

DDT is classified as a hard or persistent pesticide because it does not break down readily to form non-toxic compounds, and it remains in the environment for many years. DDT can remain toxic for 20 years. Scientists took mud from an estuary that had been sprayed with DDT 10 years before and placed some fiddler crabs in it. The DDT was still toxic and killed the crabs. DDT will get into the ocean and other water resources. It effects photoshythesis in algae which will eventually alter the amount of oxygen produced. Man drinks DDT in water and ingests it with food. It is absorbed in fatty tissue and has been found in urine and in the milk of nursing mothers. The potential danger to humans is not really known, but indeed, it is there.

To say that all pesticides should be banned is a bit drastic. Even DDT has its advantages. DDT was given credit for the elimination of typhoid fever and malaria during World War II and since then has saved crops from millions of dollars of insect damage. Other pesticides are more specific and are termed, insecticides, fungicides, herbicides, and germicides. These chemicals are helpful if used properly and can control pests and disease causing organisms. Sprays are used on shade trees, orchards, crops, gardens, household pests and the like.

Pesticides are classified as non-persistent, moderately persistent and permanent. The classification is based on how long the chemicals last in the environment. Non-persistent pesticides last from several days to approximately a month. Moderately persistent pesticides last 1 to 18 months. Persistent or hard pesticides last for many years. Permanent pesticides remain indefinitely. The most important groups are the latter two. The persistent pesticides, such as DDT, are the chlorinated hydrocarbons and also include aldrin, dieldrin, andrin, heptachlor, and toxaphene. The permanent ones contain a base of heavy elements such as arsenic, lead and mercury.

A thorough investigation of pesticides can be made by your students. Contact your state's agricultural experiment station, your state representatives and local garden shops for more information.

ACTIVITY 1:

MATERIALS (per student or team of 2 or 3 students)

- information on pesticides
- reference books
- local, state and federal regulations

As a start, look up pesticides in the library and review research papers until you decide on which class of pesticides or which specific problem you wish to concentrate on.

Define your problem or topic - state it as clearly and as precisely as possible. Read as much as you can on the topic. Write to the U.S. Environmental Protection Agency and to your State Department of Environmental Protection and ask for copies of bills or laws that pertain to your topic.

Talk to resource people in local garden shops, tree nurseries, florists, nearby colleges and universities, and the state's agriculture experiment station. Take notes on what you read and on your interviews with experts. Write up your report and in doing so consider the ecological, social, economic, and political aspects of the problem.

Include recommendations on how the problems can be controlled or solved. Devise alternative plans of action and predict possible consequences to these plans.

Discuss your findings as a whole class and determine if any plans are worth implementing. If so, work with other departments in your school to carry them out and share your information with your local Conservation Commission or environmental protection agent.

RADIATION

Background: A hazard created by progress is atomic radiation. Like pesticides, atomic energy is not all bad - only some types of radiation are harmful. As a teacher you are already aware of medical uses of radiation in the location and treatment of disease by using radioactive isotopes, and in the use of X-rays in search of broken bones, decayed teeth, lung lesions and so on. Nuclear energy is being used as fuel to generate electric power and other uses of nuclear fuels are being explored everyday.

Where does radiation come from? Is it only from medical uses, power plants and bombs? What is radiation?

Radiation can be classified into three types: ionizing radiation, background radiation, and man-made radiation. Ionizing radiation is any radiation that displaces electrons (negatively charged particles) from atoms or molecules, causing ions (charged atoms) to form. Background radiation, or natural radiation, is what is naturally present in the atmosphere. This radiation comes from cosmic rays which bombard the atmosphere from outer space, and naturally occurring radioactive elements found in mineral deposits, water, and living things. Man-made radiation is that which is released when man uses energy in the form of radioactive tracer elements and X-rays in industry and medicine, and is radiation released during nuclear tests in the atmosphere.

Ionizing radiation consists of alpha, beta and gamma rays, and short-wave ultra violet light. Alpha rays are streams of positively charged particles, or Helium nuclei, emitted by radioactive elements with a penetrating power of 5 to 10 centimeters of air and can be stopped by a piece of paper. Alpha particles are not dangerous unless they enter the blood stream through an open wound or are ingested with radioactive food.

Beta rays are streams of negatively charged particles emitted from a nucleus during radioactive decay with a penetrating power of 2 to 10 meters of air and can be stopped by a thin sheet of metal. Beta radiation can cause skin burns and the beta-emitters are harmful if they enter the body of animals.

Gamma rays have no charge and are a form of electromagnetic radiation of short-wave length and high energy. (Electromagnetic radiation consists of electric and magnetic waves that travel at the speed of light such as visible light, radio waves, and X-rays.) Gamma rays are similar to X-rays but come from nuclei during fission (splitting of nuclei) and usually have greater energy. Gamma rays are more penetrating than alpha and beta rays and can be stopped only by 2.413 kilometers of air, by 93 centimeters of concrete of by 31 centimeters of lead. Gamma rays can seriously damage cells, chromosomes and genes. They can induce mutations, cause cancer, kill cells and eventually, the whole organism.

Short-wave (frequencies between 10^{16} and 10^{17} cycles per second) untraviolet radiation is more energetic than visible light (frequencies between 1014 and 1015 cycles per second). Untraviolet radiation is also a form of magnetic radiation but it is not very penetrating. Continuous exposure, however, (as many sunbathers know) will cause a reddening of the skin, stimulate the production of pigment and if exposure persists, skin cancer can result. Ultraviolet radiation will sometimes interfere with replication of chromosomes and will stimulate chemical changes. One good aspect of ultraviolet radiation is that it breaks down some steroids to form vitamin D for strong bones and teeth.

Background radiation consists of radiation from naturally occurring radioactive elements such as uranium, radium, and plutonium, and lesser radioactive elements found in water and mineral deposits; also from some carbon and potassium atoms in animals. This radiation is primarily in the form of alpha, beta and gamma rays. Background radiation also consists of cosmic rays. Cosmic rays are streams of positively charged particles, predominantly hydrogen nuclei. Cosmic rays originate outside the earth's atmosphere and have very high energies. Some cosmic rays are absorbed by the atmosphere and other rays are deflected toward the poles by the earth's magnetic field. Thus, the intensity of cosmic radiation varies from place to place.

Man contributed to the background radiation, and hence, to radiation pollution, when Wilhelm Roentgen discovered X-rays in 1895. Eventually, these were used in industry and in medicine for medical diagnosis and therapy. When radioactivity was discovered in 1896, radioactive materials were brought into the laboratories to be studied. Later, in 1934, scientists discovered they could transform nonradioactive elements into radioactive elements and they were also used by Physicians and researchers. In 1945, the nuclear bomb was developed, and whenever fission occurs with plutonium or uranium resulting in a nuclear explosion, there is intense radiation of gamma rays. There is also a residual of other radioactive elements. These particles remain in the atmospheric currents, circulate over the earth, and eventually descend as radioactive fallout.

Ever since man bombed Hiroshima and Nagasaki in 1945, we have been able to study the long term effects of high-energy radiation. Those who survived the bombing suffered from radiation sickness. Some people eventually died from it while others recovered slowly. High-energy radiation damages the cells and the mechanism for cell division and reproduction. Sometimes the cells are killed directly and other times the delicate structure of the genes and chromosomes are damaged preventing cell division. If the cells are those needed for growth and repair, their inability to divide could be very damaging. On the other hand, if they are not, normal cells can often take over their function. If chromosomes are damaged only slightly, cell division and/or reproduction of a new organism may result but the offspring are mutations. Such disorders cause leukemia, tumors, skin cancer, or deformed children, animals and plants.

Although many experiments with radioactive materials can be performed safely in a laboratory, you should demonstrate the proper techniques for handling "hot" (radioactive) materials and give the students practice with nonradioactive materials first. The following activities are not dangerous and still provide some experience with radiation.

ACTIVITY 1:

MATERIALS (per class)

- cloud chamber with radioactive source (obtained from most science supply houses)
- paper and pencil
- block of dry ice

Set up your cloud chamber on a block of dry ice according to the instructions from the manufacturer. Do not put in any radioactive source at first. Observe for 5 minutes. What do you see? Make a drawing of your observations. Where do these tracks come from?

Put in various radioactive source materials, one at a time, and observe. Draw what you see. How do these tracks compare to the background radiation tracks above? Are all the tracks you observe the same?

Compare your observations with the descriptions below:

Background radiation tracks are thin and wobble because they are traveling at a slow speed and are not very heavy (mostly beta particles and cosmic rays).

Alpha radiation tracks are straight and thick because they are traveling at a high speed from a radioactive source and are heavy.

Beta radiation tracks are straight but thinner and longer than the alpha tracks because they too are traveling fast from a radioactive source. Beta particles are not as heavy as alpha particles which explains why they are less dense.

ACTIVITY 2:

MATERIALS (per class)

- Geiger-Muller Radiation Counters (obtained from your local Civil Defense Department)
- chart paper
- graph paper
- notebook and paper

Read the instructions on how to use the Geiger counters and record the types and what kind of radiation they measure. (Probably alpha, beta, and gamma radiation.)

Make a chart so you can record the number of counts in 10 second intervals and counts per minute. Begin counting and recording for 20 minutes. Count the clicks you hear in a 10 second period. Particles enter the counter at random and therefore, you may get 6 or 7 counts during one interval and perhaps none during another.

When the 20 minutes are up, add all the 10-second interval counts together for the total. Record ____. What is the average count per minute?____. Graph your results.

Repeat the above with the other counters. What type of radiation is most prevalent in the room? ____. What is the ratio of alpha, beta and gamma radiation present? ____.

Taking one counter at a time, try to locate the major source of radioactivity of that type in the room. Record ____. What kinds of material appear to contain some radioactive elements?_____. Would you say the room is heavily contaminated or polluted with radiation?

Put a piece of radioactive material over a piece of photography paper that is covered by black plastic. If you want you can put an object (key) on the paper and hang the radioactive material above the object and the paper. Develop the paper to show that radioactive materials will expose photographic paper.

Pick up a kodak book (in any photography store) on radioactive photography. Have the students discuss the beneficial properties of radioactive elements. Have them discuss the consequences of misuse of radioactive elements. (Blackmail, air contamination, land contamination, water contamination, effects of plants and animals.)

Have the students raise seeds that have been exposed to radioactive contamination. Divide two groups of similar seeds. Treat one with radiation but not the other. Discuss the results after growth.

Write the cities that have nuclear power plants and ask for the percent of cancer in the population before and after the plant was established. You may have to ask hospitals or the local cancer society for the information.

NUTRITION

Background: Ingenious and revolutionary changes have occured in methods of mass producing, transporting, storing, packaging and marketing of food for modern man. However, in these changes there are inherent dangers and threats to man's health and survival. Artificial hormones, antibiotics, dyes, flavorings and preservatives have been added to food; remnants of fungicides and pesticides are found in agricultural products; wastes, poisons and refuse are sometimes included in large-scale food production.

Further, man's ignorance of basic food and nutritional requirements has made him the object of exploitation in profiteering by advocates of food fads, vitamins, etc. As a consequence, his diet is often not only inadequate but harmful.

In order to build an understanding of sound nutrition and an awareness of the problems inherent in mass-production and distribution of food, the student will do the following activities.

ACTIVITY 1:

In order to show the "Basic Four" essential to your body functions, have the students read Nutrition Alert. (Write to Home Economics-Consumer Services, National Canners Association, 1133 20th, N.W., Washington, D.C. 20036.)

ACTIVITY 2:

Have the students prepare a list of the foods that are essential to their diet. Then have them prepare a list of the foods they eat. Ask them to calculate the price of the junk foods they eat. Ask them what they could do with the money they would save if they did not eat junk foods.

Divide students into groups. Assign a specific class of nutrients to each group for research and study. The report to the class may be in the form of a commercial in an attempt to sell foods which supply the nutrient. The following materials should be included in the report.

___ Functions of the nutrient within the body

___ Specific nutrients most likely to be found missing or inadequate in meals

___ Foods which would supply the nutrient

___ Average servings related to caloric content

ACTIVITY 3:

Have students bring in labels from food they eat. Show movie, Food Labeling: Understanding What You Eat (F 101). Examine canned and packaged labels for sugar content (The ingredients are listed by weight, most weight listed first), dyes, flavorings, preservatives, artificial hormones, antibiotics, flavor enhancers, emulsifiers, thickenings, etc.

ACTIVITY 4:

Show movies Eat Drink and Be Wary (F 501), and Before You Take A Bite (F 2134). Discuss harmful effects of additives. Have students make a list of immediate and long range health hazards caused by additives. (The Body Breakers, Pendulum Press, Inc., 1972)

ACTIVITY 5:

Have students raise two mice or guinea pigs. Feed one from the basic four and the other junk food only. Have students draw a picture of the two animals and label the differences in them after one month. (Compare amount of hair and weight.)

ACTIVITY 6:

Have the students make a list of foods other than meat they could eat to get the proper protein. Have the students draw a chart showing the amount of energy a cow needs to live verses an edible plant. If they were the president of an overcrowded nation, would they feed their people meat or beans, vegetables, wheat, rice, etc.?

ACTIVITY 7:

Show movie Foods Around the World (2038) and discuss foods eaten in other lands. List the food customs of many people from different backgrounds which have been integrated by "American Living."

ACTIVITY 8:

Have students consider the symbolic meaning of foods in relation to social patterns in the United States:

Hot breads - an expression of hospitality in the south
Eggs - for Easter - a symbol of new life
Candy - for St. Valentine's Day - an expression of love
Turkey - on Thanksgiving - for abundance and harvest
Black-eyed Peas and Hog Jowls - for prosperity in the new year
Unleavened Bread - symbol for haste when Jews left Egypt
Bread - slang for money
Bread and Bacon - money
Bread - Christ's body
Wine - the blood of Christ
Sugar - an endearing term
Honey - an endearing term
Carrot top - Red headed person
Mustard seed - faith
Nuts - crazy
Corny - unsophisticated humor
Bananas - crazy
Grass - Marijuana
Adam's Apple - esophagus

ACTIVITY 9:

Set up a "Scramble Table" of pictures depicting the various foods that are commonly associated with their "meals." Divide into groups and assign each group a "meal." Ask the students to select from the "Scramble Table" those foods they associate with their "meal" and illustrate by use of the flannel board.

ACTIVITY 10:

Have the students in each group prepare a different vegetable by various methods: small amount of water; with or without lids. Observe the effect of each method on color, flavor, other.

Have the students test for:

Protein: Protein plus Biuret Solution yields purple liquid
Starch: Starch plus iodine yields blue black color
Sugar: Sugar plus Benedict's Solution (heated) yields green then orange color (mix sugar and Benedict's Solution in test tube then heat over Bunsen Burner)
Fat: Fat plus brown paper yields grease spot on paper
Iodine: Iodine salt plus heat in test tube yields purple gas (for control test use PbI, or KI)

Then have the students test junk food to show them what they are getting for their money. Then show A Chemical Feast and Brand Name and Labeling Game. (Films from LRC)

OBJECTIVE:

To describe the interaction between the environment and stages of man's physical, social and economic evolution.

ACTIVITY 1:

Many business and civic leaders believe that "growth is good," and "more is better." To gather first-hand evidence of these attitudes, have students interview community leaders, using the questionnaire on following page. If each student interviews two or three community leaders, the combined results should be suggestive enough to reveal these attitudes.

Sample Respondents:

- Chamber of Commerce officials
- local department store managers
- real estate agents
- retail store owners
- civic club leaders (Rotary, Lions Clubs, etc.)
- government officials
- stock brokers
- manufacturing plant management

When students have collected this information, the answers should be tabulated and analyzed. Code the results by computing percentages for both "yes" and "no" responses. It is important to point out that this is not a large enough sample for proper statistical analysis: this simple exercise will yield impressions only. But they are impressions gained from leaders of the community who are influential in shaping attitudes towards community as well as national growth.

QUESTIONNAIRE

1. The recent report on Population Growth and the American Future suggests that national population growth should be slowed. Do you agree with that recommendation?

   Why? ______________________________

   ____

   ____

2. Do you think that a slower rate of national population growth will hurt the nation's business and economic activity?

   Why? ______________________________

   ____

   ____

3. With respect to your own job or business ______________ (identify) would a slower rate of national population growth hurt your activity?

   Why? ______________________________

   ____

   ____

4. How do you feel about the future growth of your community? Do you think that the population of your community should stay at its present size?

   Why? ______________________________

   ____

   ____

ACTIVITY 2:

To develop a strategy for political action in a political system, have students study a local problem dealing with the natural environment. Look at a political problem that has been occuring in your community. The problem is a case study - an example. It is not a situation in which the whole environment depends on, but it is the type of situation that can be found over all the country - making up the environmental crisis.

It should be stressed that this activity does not take a stand on what should be done with the case. Instead, it has the student develop his own decision and then, through certain exercise, has him develop his own strategy to put that decision into effect.

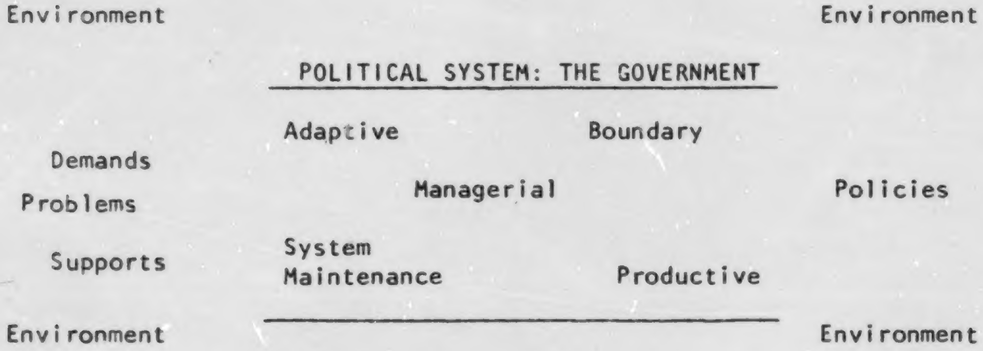
The problem was chosen for the following reasons:

1. It is close to the student, affecting his community and therefore his life...
2. It is representative of the type of problem that makes up the environmental crisis in that both sides have legitimate concerns...
3. The problem is relatively simple, few interests are directly involved at this time.

For Discussion:

1. Review the above functions. Can you give examples of political problems that would endanger the satisfying of each function?

2. Study this illustration. Can you explain it given the above description?



3. Apply the ideas of system and functions to your family. Pick one of the above functions and explain how your family must satisfy it in order for your family to continue as a family. What responsibility does satisfying that function give you as a member of the family?

4. What do you suppose you find in the "environment" of a political system?

ACTIVITY 3:

POPULATION GROWTH - Population grows when the number of people born each year plus those who immigrate to a country exceeds the number who die plus those who leave.

The rapid growth in the world's population as a whole is a recent development in man's history. Until the industrial revolution was well on its way, birth rates around the world were high, but hunger and disease stacked the odds against infants surviving to the age of parenthood. Societies required high birth rates simply to maintain their numbers.

With the introduction of modern health measures, death rates have dropped dramatically while birth rates in most of the world remain high, resulting in rapid population growth. In the Western world improved sanitation, medical care, and economic conditions were accompanied by the widespread use of contraceptive methods, which together brought about a new pattern of low death rates and low birth rates. This important change, known as the demographic transition, took about a century and a half in the industrialized nations, but it has not yet occurred in the developing nations.

Since World War II drastic reductions in mortality in developing nations have not been matched by equal reductions in the number of births. Instead of narrowing, the gap between birth rates and death rates has widened in these countries, the rate of natural increase has risen steeply, and world population growth consequently has accelerated.

The world's population grew from one-half billion around 1650, to about 2.5 billion in 1950, and has already grown beyond 3.5 billion in 1970. If current rates continue for another 50 years, the world's population will reach 10 billion.

Although the United States has always been a nation of growing population, the rate of growth has declined considerably during the twentieth century. Substantial changes have occurred in all three components of population growth - fertility, mortality, and migration. At the beginning of this century, the birth rate was about 32 births per 1,000 population and declined to about 18 per 1,000 during the Depression. After World War II, the birth rate shot up to a high of 27 per 1,000 and remained almost as high for a decade giving us the "baby-boom" era. By the early 1960's the boom had run its course, and our birth rate today is below pre-World War II levels.

Our society's ability to preserve and extend life has caused the death rate to fall from 17 per 1,000 persons in the year 1900 to about 9 per 1,000 today. Furthermore, the average life expectancy of Americans has increased 23 years since 1900, giving us an average life span of 70 years.

Immigration is also a major determinant of the growth rate. During the first decade of the 20th century, almost 40 percent of U.S. population growth was due to immigration. During the 1930's the number of immigrants was actually lower than the number of people leaving the country. Immigration once again increased following World War II and during the 1960's it accounted for about 16 percent of our national growth.

While the proportion of our population that is foreign-born is not changing much, the relative importance of immigration as a component of population growth has increased as the birth rate has declined.

These changes in fertility, mortality, and migration have produced a long history of diminishing growth rates. The annual rate of growth has dropped from about 3.3 percent during the 1820's to a low of around 0.7 percent during the Depression. After a rise stimulated by the baby-boom era, the present rate of growth has leveled at about 1.0 percent. Today, however, the size of the population is so large that even the low current rate of growth produces an additional 2¼ million people each year.

DEMOGRAPHIC PERSPECTIVE OF 20TH CENTURY UNITED STATES

	1900	1970
Population	76 million	205 million
Life Expectancy	47 years	70 years
Median age	23 years	28 years
Births per 1,000 population	32	18
Deaths per 1,000 population	17	9
Immigrants per 1,000 population	8	2
Annual Growth	1 3/4 million	2 1/4 million
Growth rate	2.3 percent	1.1 percent

ACTIVITY 4:

The birth rate measures the number of babies born in one year for each 1,000 persons in the population at the midpoint of that same year:

$$\text{BIRTH RATE} = \frac{\text{NUMBER OF BIRTHS PER YEAR}}{\text{POPULATION}} \times 1{,}000$$

Similarly, the death rate is the number of deaths in one year per 1,000 population:

$$\text{DEATH RATE} = \frac{\text{NUMBER OF DEATHS PER YEAR}}{\text{POPULATION}} \times 1{,}000$$

Net migration is the difference between the number of people who enter the country in one year (immigration) and the number who leave (emigration):

$$\text{NET MIGRATION} = \text{IMMIGRATION} - \text{EMIGRATION}$$

Net migration can be converted to a "per 1,000" figure and added into the equation to yield the growth rate:

$$\text{GROWTH RATE} = \frac{\text{BIRTH RATE} - \text{DEATH RATE} + \dfrac{\text{NET MIGRATION}}{\text{POPULATION}} \times 1{,}000}{10}$$

Doubling time is the number of years needed to double the original population size, depending on a country's rate of population growth, e.g.:

Growth Rate	Doubling Time
1%	70 years
2%	35 years
3%	23 years

The riddle below serves as a springboard for discussing the doubling of the population. Students should be given the riddle and a few minutes to figure it out. Each student should be encouraged to arrive at his or her own answer before comparisons are made. If the class is slow, the teacher might want to have the students work in groups of two or three to solve the riddle.

"Suppose you own a pond on which a water lily is growing. The lily plant doubles in size everyday. If the lily were allowed to grown unchecked, it would completely cover the pond in 30 days, choking off the other forms of life in the water. For a long time the lily plant seems small, and so you decide not to worry about cutting it back until it covers half the pond. On what day will that be?"

- Donella H. Meadows, et al., The Limits to Growth (New York: Universe Books, 1972), p. 29.

As first, some students may guess that the pond will be covered on the fifteenth day, others on the twenty-ninth day. It may be surprising to the students to find out that the pond will be only half-covered on the twenty-ninth day, and completely covered one day later. The students should discuss why everyone did (or did not) agree that the lily pad would cover half the pond on the 29th day.

ACTIVITY 5:

The following activity begins to explain the difference in future population growth resulting from an average family size of two children and one of three children. A skein of brightly colored yarn is needed for this activity. The chairs in the room should be pushed against the walls so that a large, open space is available. The activity works best in large groups (50 or more), although it can be used in smaller classes as well.

Two students are selected to be a "mother and father." This couple is given three pieces of yarn to indicate that they will have three children. They select three students in the group to represent their own family of three children and connect them to the parents with the yarn. Each of these persons is then given three pieces of yarn and selects three students to represent his or her children. Again the new "parent" is connected to the children with yarn. The process continues until all of the students are selected.

After doing the exercise, the students should diagram the activity. They may want to carry the diagram farther on paper than was possible in class (e.g., four, five, or six generations). The teacher might ask: "How many people have been born into the world after two generations? after three? four? six? ten?"

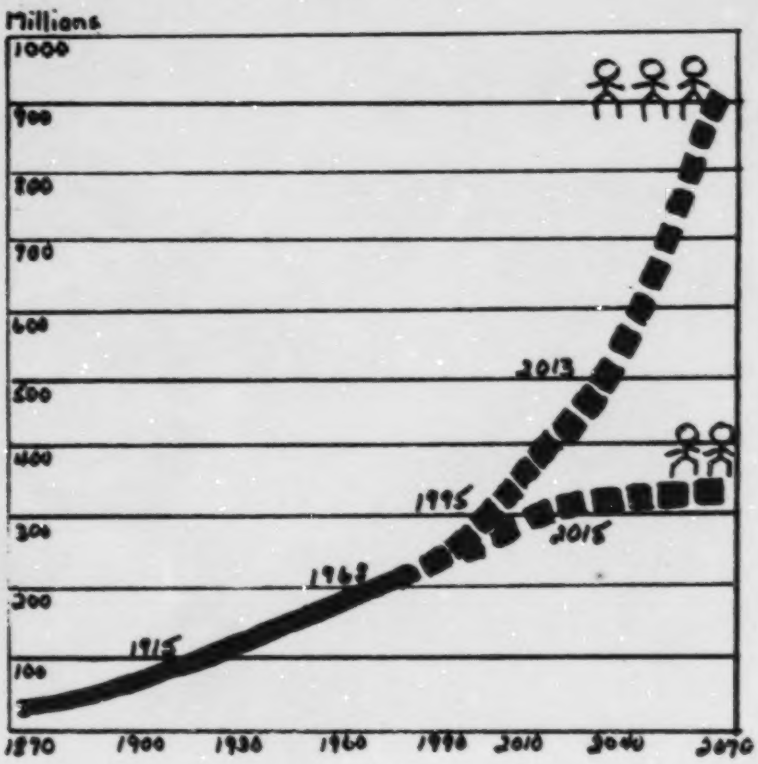
After a brief discussion, the yarn activity should be repeated with one modification. The couples should decide to have two children. Then a second chart should be drawn. Students should spend the rest of the period analyzing the data in the charts and making comparisons between them. Various hypotheses and generalizations can be drawn from the data (i.e., if the number of children per family is reduced to two, instead of three, then the number of years it takes for the population to double should increase).

ACTIVITY 6:

The preceding activity oversimplifies reality. In group discussion, be sure to account for the following:

1. There will always be a range of family size in society. Some people won't marry. Some couples will choose to have no children, while others may have one, two, three or more children.
2. For the sake of simple example, the activity only follows one family line. Note, however, that the rate of growth indicated in both the 2-child and 3-child exercises is overstated because offspring are shown in proportion to one parent only.
3. Deaths are not figured into this exercise. Students are learning about the number of people born into a hypothetical world, not the number of people existing in it.
4. The length of generations varies. To illustrate this, the length of yarn pieces may be varied.
5. According to the graph what was the population of the United States in 1968? What will it be in 1995?
6. In which year did (will) the U.S. reach a population of 100 million? 200 million? 300 million?
7. What will determine whether the population is greater or less than 300 million in 2010?

U.S. POPULATION: 2- vs. 3- CHILD FAMILY



ACTIVITY 7:

Autobiography Part I - Persons are born and they die - these two events enclose a lifetime. During this lifetime, all kinds of population events occur. Using your own life, develop an autobiography outlining population events in your life, past, present, and future. For example, the times you moved as a child, plans you've formulated for your own family, and your occupational prospects might be included. You may wish to think of your lifetime as having three parts: (1) the period between your birth and the present; (2) the period between the present and the near future - the years immediately after you leave school; and (3) the distant future - perhaps beyond age 30, to old age.

ACTIVITY 8:

Autobiography Part II - On the following page is a form for listing important facts that shape the lives of population factors. Some are factors that may only slightly influence your population behavior, while others are the very basis for the decisions that you make. When this list is completed you will be able to chart the determinants and consequences of your own population behavior.

A. PERSONAL CHARACTERISTICS

Age __________ Year of Birth ____________ Sex ___________ Race __________

Birthplace ______________________________________ Approx. Size
town state of Birthplace ___________

Present Residence ______________________________ Approx. Size
town or city of Present
Residence ______________

Life Expectancy ____

Future Occupation ________________________ Intention to Marry _____________

Expected Number of Children __________

In what ways are these facts important to you as a population factor? For example, does your sex or race influence your life expectancy? How else might these facts influence your chances in life? Do you live in the same town in which you were born? Why or why not?

B. YOUR ANCESTORS

	Birthplace (state or country)	present residence	life span (length of life)
1. Grandparents			
mother's mother			
mother's father			
father's mother			
father's father			

Does the migration history of your grandparents have any implications for you? For example, if they were born abroad, do you retain any of their ethnic characteristics - language, food, social customs? After coming to the United States did they settle in a rural area or in a city? Are any of them still alive? Do they live with your parents, nearby, or far away? How does this affect the life of you and your family? Fifty years ago, what do you think the family structure might have been? If any of your grandparents are no longer living, how many years did they live? Is it likely that you will live longer than they?

2. Parents	birthplace	age
mother		
father		

At what age did they marry ____________________ ____________________
(mother) (father)

You are no. ____________ of ________________ children.
(1,2, etc.)

Migration after marriage:

Name of place	rural	urban center	suburb
(1)			
(2)			
(3)			
(4)			
(5)			
(6)			

During what time in American history did your parents marry, e.g., World War II? postwar? How might this influence their decisions on the size of their family? How did the events which occurred during their lifetime (wars, job changes) influence their migration history?

C. YOUR MIGRATION HISTORY

Name of Place	rural	urban center	suburb
(1)			
(2)			
(3)			
(4)			
(5)			
(6)			

What effects, if any, did these moves have upon your life? Do you remember changes in school, changes in friends, and changes in playground and recreational opportunities?

D. YOUR PRESENT AND THE NEXT FEW YEARS

Do you plan to marry? ____________________ Why? ____________________

If not, what alternative living styles can you think of? ____________

____

If so, when do you think you will marry? Age__________ Do you think your spouse will be older or younger?__________

Would you prefer to marry before or after you complete your education?
__________ What factors might cause you to alter this plan?
____

Do you plan to have children?__________ Why?__________
____

What factors might cause you to alter this plan?__________
____

At what age would you like to have your first child?__________

How long after marriage would this be?__________ Why did you decide upon this time?__________

How many children do you want?__________ Why?__________
____

How many children, more or fewer, do you want than your parents had?
__________ Why?__________

Would you like to space the births of your children?__________

Closely?__________ Far apart?__________

Why?__________

Would you consider adopting children?__________ Under what circumstances?__________

Do you see potential role conflicts for yourself in combining marriage, childbearing, education, and a career?__________

If so, can you think of ways to resolve these conflicts?__________
____

When you complete school, or if and when you marry, where do you expect to live?__________

Is this the same community where you live now?______________________

If not, why will you move there?______________________________

How would you classify this move? (For example, rural area to city, city to suburb.)______________________________________

What will be the consequences for the community in which you live and the one to which you will be going?______________________________

____

____

E. YOUR FUTURE

What kind of decisions are you making as a population actor? What moves and occupational changes do you anticipate? Where would you like to live when you get older? Do you prefer any particular region? Why? Would you prefer to live in the suburbs, the city, or the country? Why?

If you have children and your youngest child is born when you are ______, by your best estimate, you will be _______ when this child leaves home for college or his or her own home. This means that you would have ________years at home without children until retirement. What implication does this have for your role as husband or wife?

Similarly, at retirement, how many years of life will you have left? (Retirement age compared to life expectancy at age 65.) How will you plan for these years? How might your life change without employment?

ACTIVITY 9:

THE NEWLYWED GAME

The class is divided into pairs of newlyweds faced with a list of immediate decisions that must be made. Based on their occupations, projected income, and preferred lifestyle the couples must develop a list of criteria for a place to live, a place of employment, a means of transportation, and any other items or resources they will need to "set up housekeeping." Then, they must determine that their plans are realistic by: balancing a budget; locating available housing; pricing items that will have to be purchased; talking through an imaginary week to make sure that they have worked out all of their needs as well as their leisure time activities.

After they are set in their imaginary routine, they arrive home to discover a newspaper on their doorstep headlined, "NEW OIL EMBARGO: TALKS DEADLOCKED". As they read on they realize that this embargo will affect more than the price of gasoline and is likely to be extended indefinitely. The President has responded to the emergency by ordering a 50% reduction in all petroleum consumption effective at midnight. This means that oil-using power companies will be allowed to produce only half as much electricity, service stations will be allocated even less than half of their present gasoline allotment because of a priority rating for emergency vehicles, one member of each pair will lose their job (the most energy dependent occupations of the two),...and so on. The couples are to predict the immediate and longer range effects that this will have on their lives as well as how they will adjust their lifestyles to accommodate these constraints.

Students can now drop their roles and answer the following:

1. Knowing in advance that an "energy crisis" was imminent, could you redesign a more energy-efficient or energy-independent lifestyle? Specifically, what would you do differently?

2. If you were convinced that the per-capita energy consumption of all U.S. citizens would have to decline appreciably in the remainder of this century, never again rising back to its present height, would you plan any differently for YOUR lifestyle (those things you want to do, become, and have)?

3. What do you think would be the most effective means of convincing people of the need for adopting more energy-efficient lifystyles?

Needs Checklist:

Type of dwelling (house, trailer, apt.)	
Location of dwelling	
Size (number of rooms, etc.)	
Heating and air conditioning preference	
Recreational access	
Laundry facilities	
Possible occupations	
Place of employment	
Means of transportation	
Furnishings	
Kitchen equipment	
Linens	

Appliances ______________________________

Others ______________________________

Monthly Budget:

Income ____________________

Expenses - ____________________ = ________________

Rent	Medical	
Electricity	Insurance	
Water	Clothing	
Sewage	Household items	
Telephone	Laundry	
Cable TV	Recreation	
Food	Time payments	
Transportation	Savings	

PERSONAL ENERGY INVENTORY

Your lifestyle depends on the kinds and amounts of energy available to you. Conservation efforts are essential in all aspects of energy usage in order to prevent drastic measures as were taken during the oil embargo.

Any change in the amount of energy available to you will affect your lifestyle.
Some of our energy sources are not renewable.
Your personal energy consumption efforts can be measured.
Your personal energy conservation efforts can be detected and these efforts save money.

Do the following:

1. Make a list of the things that you and your family could do to save energy without being painfully uncomfortable.
2. Find your gas or electric meter (or both). Learn how to read them. Your teacher will help you with this after you have had ample time to learn it yourself.
3. Take a reading on a Sunday evening, read your meter again the following Sunday afternoon at the same hour as before. How much energy did you use?
4. Make a list of everything in your house that uses that energy.
5. Now work out with your family a plan you can use to cut down on the use of energy for one week. Write down your plan and try to get everyone to follow it.
6. Again, measure the amount of energy (gas or electricity) used

over a week when your family was following your conservation plan. How much did you save? Could other factors such as cold or hot weather make a difference?

7. Compare your home's energy use with your classmates. Why are there differences ?
8. Find out how much one kilowatt hour of electricity cost. Calculate the amount of money you saved on the family's utility bill.

> "Nature never gives anything away.
> Everything is sold at a price.
> It is only in the ideals of
> abstraction that choices come
> without consequence."
>
> -Ralph Waldo Emerson

ACTIVITY 10:

To show that members of a population tend to exhibit definite spatial distributions, obtain a current road map of Florida. Using all the keys available on the map try to make some generalizations concerning the population densities in Florida.

1. If you draw a line 5 miles inland from the edge of the sea, what percentage of the population would live in this narrow strip around the state?
2. Why do people concentrate in this area?
3. Ecologically, is this the best place for them to live? Why or why not?
4. Why have the Orlando, Tampa, Jacksonville, and Miami areas grown so large? Is this a good thing?

ACTIVITY 11:

To show that man may induce enough changes in the environment until he is no longer able to survive, divide the class into groups. Using a basic outline map of the community, have one group show the area as it exists today; have a second group show the area as it was 25 years ago; a third group should depict it as it was 50 years ago; and a fourth group, as it was 100 years ago. This information can usually be obtained from town records. To discover what your local area was like in the eyes of its residents, have one group interview residents of the town who have lived there for 25 years. Have another group interview a 40 to 50 year resident of the community. When all data has been collected and summarized, list the changes which have occurred.

1. Were these changes helpful or harmful to the people; to the environment? Explain.

2. Looking back, what could have been done to prevent the harmful changes?

3. Looking ahead, based on what we now know, what changes do you forsee?

4. Will these be helpful or harmful? Explain.

5. Will the harmful changes destroy us?

6. What can we do to prevent the harmful ones?

7. How could this process you have employed be modified or use on a national scale?

ACTIVITY 12:

Discuss with the class the differences between old cemeteries and modern ones and why certain changes have occurred. Try to get them to think about what might happen in the future when population growth begins to put more pressure on land use.

Using the stories below: discuss common myths and superstitions concerning cemeteries. Ask a few students to share some folk stories about old cemeteries in them.

OLD-TIME BURIALS

Many superstitions and ghost stories have had their beginnings at old-time burials and wakes and graveyards. Maybe it was the way some of the supposedly dead people suddenly woke up. or the way the bodies were hauled to the church for the dramatic ceremonies held there. Nevertheless, the fascination was fact. Aunt Arie told us in hushed tones of a neighbor who was shot during a fight and died with his eyes open -- "blared," and she called it. "And you could see the devil in 'em--them fightin' y'know."

And Ethel Corn told us of a neighbor's wife who had to be dug up and moved from the old family plot to a graveyard nearby: "And she'd been dead for about twenty-odd years. They said when they took her up and opened that lid, there was glass over it so no air couldn't get in. And said she looked just exactly like she did when they buried her. And then they raised the glass, and when they did, said it all just went down flat to nothin'."

Dr. Rufus Morgan, a retired Episcopal minister, told us that it was very easy for him to see how superstitions and ghost stories might arise in this connection. "I might tell you one little story," he said. "Up here at St. John's Church is where it happened. I was born in a log cabin the other side of the church. One evening, my mother had been down to visit her parents and was on her way back and was passing the cemetery at late dusk. As she passed, she saw a white figure in the cemetery. She was rather surprised. She stopped, and the figure just stood there. Then she started on and the figure started after her. She stopped again, and the figure stopped. She started again, and it repeated the movement. Finally she stopped for a longer time. Most people would have beat a hasty retreat, but she waited and the figure came up to her. And it was an Indian mother who had been at the grave of a child that had been buried there.

That's the way superstitions in regard to ghosts arise. They can develop very easily if you are afraid.

Another thing--my longest hike, which was something over two hundred miles in five days, went from up above Albany, New York, into Boston --the length of Massachusetts. I had a blanket and a frying pan--just bare necessities--and I'd camp out overnight.

Well, I got along toward the eastern part of Massachusetts, and I couldn't find open space which was suitable for camping. It was getting dark. By the time I left one town, I'd be in another.

Finally I came to a cemetery by a church, so I said to myself, 'that'll be safe. Nobody'll bother me there.' So I went in and found a nice place between two graves, and, wrapped in a blanket, I went to sleep.

Along ten o'clock or so at night, I felt something, and I couldn't tell at first just what had waked me up. I listened and felt, and finally I discovered it was just beginning to rain on me. So the disturbance wasn't the ghost at all. Just the rain."[1]

---

[1] Eliot Wigginton, ed., Foxfire 2, (Garden City: Doubleday and Company, Inc., 1973), pp. 304-305.

ICE COLD HAND

by William E. Hollman

It happened sometime in the late eighteen hundreds in the summertime. A young man by the name of George Scott had been going with this girl, a lovely Southern girl, and she loved him dearly. They were planning to get married in the early fall. He decided for some reason that he.. well, wasn't ready to get married and broke the engagement. She was just grief stricken. Before long she became ill, caught typhoid fever, I think. She got worse and worse and finally died. He was upset about it, but not too much, because he went on with the other boys to see other girls.

Around Christmas he and a bunch of young men were going to a party. They had to walk back home in those days. It was two or three miles on a narrow, winding road, so narrow only one buggy could pass, and grown up on both sides. They had to go past the very graveyard where his girl friend was. As they got right opposite the graveyard, they say this funny-looking fog, a white form coming toward them. The other boys took off and flew, scared to death, and left him, but George Scott stood stock-still, petrified, because he knew who it was and it couldn't be anybody else. He didn't speak and she didn't either. The white shape touched him. Its hand was icy cold. Then it vanished.

The others had gotten to the house, where they told what had happened and excited everybody. Some went back to see if they could find him, and they did. He was still in a daze. A few months later his health went bad and he died young. And that's not all. He was buried in the same cemetery not far from where the girl was. His parents put up a white tombstone about four feet high. After he'd been dead about forty years, the news got out that there was the likeness of that girl's face on his tombstone. It was some kind of discoloration, very visible, lifesize. She'd been dead, of course, a long time, but people who'd seen her picture declared for sure it was she and nobody else. People came from miles around to see it.[2]

---

[2] William E. Holloman, "The Ice-Cold Hand," North Carolina Folklore Journal, February, 1974, Vol. XXII, No.1, pp 3-4.

CENSUS OF THE CEMETERY (RECORD FROM 15 STONES AT RANDOM)

NAME BIRTH DEATH AGE

1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

6. ____________________

7. ____________________

8. ____________________

9. ____________________

10. ____________________

11. ____________________

12. ____________________

13. ____________________

14. ____

15. ____

Tally the ages of the above poeple in the age groups below:

0-10 ____________________

11-20 ____________________

21-30 ____________________

31-40 ____________________

41-50 ____________________

51-60 ____________________

61-70 ____________________

71-80 ____________________

81-90 ____________________

During what age group did most people die? ____________________

Could you guess the reason for this? ____________________

List several epitaphs found on the stones:

____

____

____

____

____

____

1. Take the class on a field trip to a nearby cemetery.
2. Give the students the worksheets to be completed at the cemetery.
3. Make some rubbings of any interesting markers.
4. Take a polaroid camera to take pictures of any unusual tombstones.
5. Divide the class into groups of five students and have each group compile the results from their worksheets and figure the ages from the data on the thirty people listed on the worksheets.
6. Assign each students to one of the following groups:
    a. Mount rubbings on poster board
    b. Make picture display using photographs taken at the cemetery. Make a caption as to why each picture is of interest.
    c. Write some poetry or a story about an unusual tombstone or statue seen at the cemetery.
    d. Write a ghost story about the cemetery you visited or someone buried there.

7. Have each group complete their projects. Display the student's work either on a bulletin board or in some section of the room.

The following worksheet should be completed by students at the cemetery.

The Cemetery:

1. Is this a "live" or "dead" cemetery?______________ Why?

____

2. What is the oldest date on a stone? Birth________________

Who?______________________ Death____________________

Who?______________________

3. Estimate how many more graves can be placed in this cemetery using the same space as now used.____________________

____

4. What kinds of trees are in the cemetery?________________

____

5. Is there a fence around the cemetery?____________________

B. The Stones

1. What materials are the grave markers made of?____________

____

2. Find the stone of the oldest person buried here. Name______

______________________ Date of Birth________________

Date of Death__________________________ Age__________

3. Can you determine the youngest? Name____________________

______________________ Age______________

4. Do any graves have field stones as markers?______________

5. How many graves have insufficient data to use in a Census?

____

C. The People

1. Which two families have the most names on stones?____________

____

2. Are more males or females buried here? Males ______________

Females______________________

ACTIVITY 13:

This activity is designed to trace population growth from 10,000 B.C. to the present time. Through the use of transparencies and discussion, the class will examine the size of population to help reach a better understanding of why we have a population prpblem and how it is getting greater.

Show Transparency #1 - Problems of Overpopulation

One of the most serious threats to mankind and to the quality of life is overpopulation.

Show Transparency #2 - Under-Nourished and Mal-Nourished

Within 30 years, the rich nations of the world may be surrounded by a sea of famine involving hundreds of millions of human beings, warns Lord Snow, British scientist and author. In some areas of the world, population growth has already outrun food supply and we have starvation today. In the underdeveloped nations there are now about 10,000 deaths each day due to starvation. This is one death every 8.6 seconds.

Show Transparency #3 - Determiners of Population Density

In order to understand why our world is overpopulated today, we must examine the factors which regulate the size of a population.

Denisty refers to the number of individuals that occupy a particular space. A population will undergo changes in density over a period of time due to four determiners. Natality and immigration increase population; mortality and emigration decrease population.

Ask the students what environmental factors influence an increase in mortality or emigration. Food supply will obviously be a reason. Some animals will starve if they remain in an area with a diminished food supply; others may emigrate from the area of low food supply to another area with a more favorable food supply. High food supply may be a major factor in increased natality and immigration. Several other factors, such as seasonal immigration, overcrowding and social behavior, can be discussed as they relate to the determiners of density. The formula for determining density is:

$$\text{Density} = \frac{\text{Number of Individuals}}{\text{Space Occupied}}$$

Show Transparency #4 - Terms

Show Transparency #5 - History of Population Growth

1. 10,000 B.C. - Man's population began increasing as his food supply increased. At the time of the cave man the birth rate was high but the population grew very slowly because of the limited food supply and the high death rate.

2. 6,000 B.C. - As man began to settle down and grow his food, population slowly increased. An agricultural society can support 200 to 400 times as many people as a hunting and food-gathering culture. However, several factors kept the population from growing too rapidly. Tools and techniques for cultivation were quite limited. Land for farming was also limited since clearing forest areas required more sophisticated tools.

3. 1348 - 1379 A.D. - Population increased in Europe rather steadily until the middle of the 1300's, then it was drastically checked. Between 1348 and 1379, 20 million died in Europe. That is about 400 times the population of Asheville. Many believe that population in Europe had expanded to the limits of the available technology. This is one example of how natural causes can check population growth.

4. 1620 A.D. - Between 1600 and 1700 the population began to grow more rapidly for several reasons:
   a. The opening up of new continents
   b. The expansion of commerce
   c. Technological changes in agriculture

5. 1650 - 1750 A.D. - When men found that diseases were caused by germs, death control was fully underway. People who would have died were now living and reproducing.

6. 1750 - 1850 A.D. - The population growth curve began to climb quite rapidly. Up until the middle of the 1800's, the growth rate increased steadily.

7. 1850 - 1959 A.D. - About 1900, a demographic transition occurred accompanying the Industrial Revolution. In the industrial countries the birth rate began to drop. Why does the birth rate drop with industrialization? Children in an industrial society are not potential producers, they are consumers. They require extensive care, feeding, and education. Large families, which became more likely with lowered death rates, tended to reduce mobility and to make the accumulation of capital more difficult. Even in rural areas there is only a finite amount of land which has to support more people. Mechanization has also reduced the need for farm labor. Therefore, rural birth rates drop as many people move to the cities.

Show Transparency #6 - U.S. Birth Rate and Population Growth

Show the Birth Rate Graph

By looking at the birth rate in the United States, we can see the effects of the Industrial Revolution. The birth rate is influenced by many factors - age structure of the population, age at marriage, marriage rate, number of women in the work force, degree of urbanization, state of the economy, availability of housing, and what people feel is the ideal family size. In the first part of the 1900's the birth rate in the United States began to decline from the high rates of the 1800's. The Depression accelerated the decline until fertility bottomed out between 1936 and 1940. After World War II, the birth rate increased. Several reasons can explain this rise - men had been separated from home and families, the men from the war had an increased appreciation of home, large family provided the kind of security the war had denied, and the ideal family size was seen as 3 or 4 children. The birth rate continued to increase until about 1960. In the 1960's the discovery of more effective birth control methods combined with a more unstable economy, caused the birth rate to begin to drop.

Show the Population Growth Curve

Even though the birth rate has fluctuated in the 1900's the growth rate (the birth rate minus the death rate) has steadily increased. As long as fertility remains above replacement level, a natural increase is assured. Only when fertility reaches the point where women are having so few children they are not replacing themselves, will the population decline. Before each year is out, enough people are added to our country's population to create a mammoth new city the size of L.A. This net increase of approximately 3 million persons is roughly equal to the combined populations of Rhode Island, Delaware, Idaho, Nevada, and Montana. What can we expect in the future?

In the baby boom following World War II, nature provided a full quota of little girls. These girls are now entering the 18 age group that accounts for 85% of all births. If births increase as fast as women in this age group, a rather safe assumption, the annual number of persons added each year could jump from three million to seven million!

In 1936 - 24% of the population was women of child-bearing age
In 1967 - 20% of the population was women of child-bearing age
In 1975 - 37% of the population will probably be women of child-bearing age

Women in the 20-29 subgroup bear most children; this group is projected to increase until 1980. After 1980, the size of this subgroup will begin to decline as the babies of the low-birth rate 1960's enter their reproductive years.

Show Transparency #7 - World Population

Show the Birth Rate Curve of the Developing Countries

The birth rate in developing countries has remained high. These countries have not undergone industrialization and the demographic transition which accompanies it.

Remove Transparency without showing the World Population Growth Curve

Show Transparency #8 - Fewer Babies Die Today

In 1900, 162 out of every 1,000 babies died. In 1969, only about 22 out of every 1,000 babies died. Today, because of death control, children who at one time would have died at birth are now living to be old enough to reproduce. The control of death is a major reason why our population is increasing so rapidly.

Show Transparency #7 - World Population

Refer back to Transparency #7 and show all three graphs

With birth rates in many countries still very high and death rates steadily declining, the result is a world population which is shooting straight up. For thousands of years, the total number of people stayed low. As man increased his food supply, population grew. You will notice on the graph of the world population that our numbers started to increase the most between 1650 and 1750, when man began to understand and combat the causes of disease.

Make a chart of the following on the blackboard, then have the students make a graph of the growth of the world population.

It took thousands of years for the earth's population to reach ¼ Billion at 1 A.D. 1600 years later in 1620, the population doubled to ½ Billion. A little over 200 years later in 1850, the population doubled to 1 Billion. 100 years later in 1930, the population doubled to 2 Billion. In only 45 more years our population should have doubled again. In 1975, the world population was about 4 Billion.

Show Transparency # 9 - Overpopulation - World Population

This is another type of graph which shows how the world population is increasing.

Show Transparency #10 - Doubling Time

What will be some of the effects of a rapidly increasing population

Read the transparency then ask the class what could be other effects of overpopulation.

Show Transparency #11 - Prey - Predator Relationship

This shows what happens when a population outgrows the ability of its habitat to provide food, shelter, and other things necessary for survival. Predators keep a population in check. When the predators are removed the population will increase very rapidly until it reaches a certain point. After this point, the population checks of starvation and lack of reproduction reduce the population. Usually the population is decreased to a reduced carrying capacity.

The following questions could be used for discussion:

1. In the past what factors or things could be considered predators of man?
2. Do you think the human population will increase indefinitely?
3. What will determine the carrying capacity of the world as it applies to humans? (starvation, lack of reproduction, deformed infants, abnormal behavior)
4. Is there evidence that a human population anywhere in the world has reached the carrying capacity of that area?
5. Is there any evidence that the human population is presently causing its supportive environment to deteriorate? (pollution)

OVERPOPULATION

SOME PROBLEMS OF OVERPOPULATION

MORE SMOG, NOISE,
GARBAGE, LITTER. . .

TENSION, BLIGHT, SLUMS,
CROWDING, CRIME, CONGESTION . .

SHORTAGES OF MINERALS, WATER
OPEN SPACE . . .

NEED MORE FOOD, HOUSING, SCHOOLS, TRANSPORTATION, HOSPITALS

OVERPOPULATION

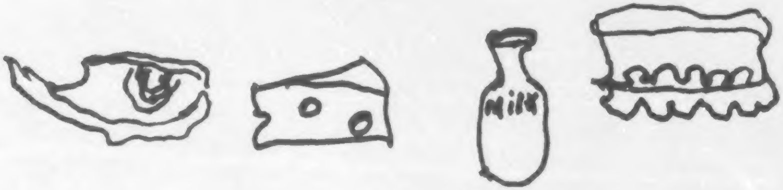
PRESENTLY. . . . .1/2 OF THE PEOPLE IN THE WORLD ARE EITHER UNDERNOURISHED OR MALNOURISHED.

MALNOURISHED

PROTEIN

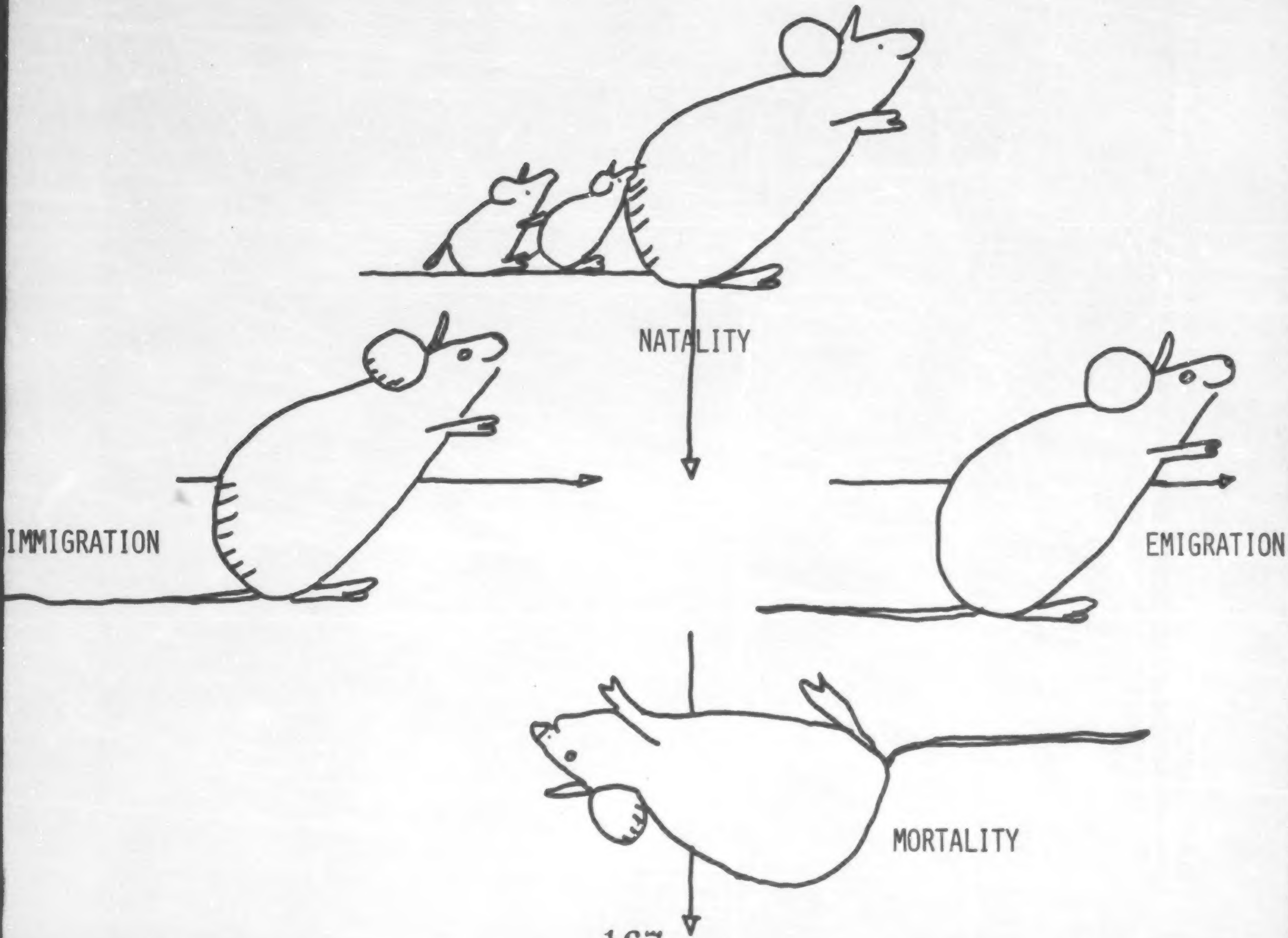
IN THE WORLD - 10,000 FATALITIES A DAY
DUE TO MALNUTRITION

WORLD PROTEIN PRODUCTION IS NOW 80 MILLION TONS A YEAR. IT MUST BE EXPANDED 20 MILLION TONS TO FURNISH ADEQUATE DIETS



THERE IS NOT ENOUGH FOOD TODAY!

DETERMINERS OF POPULATION



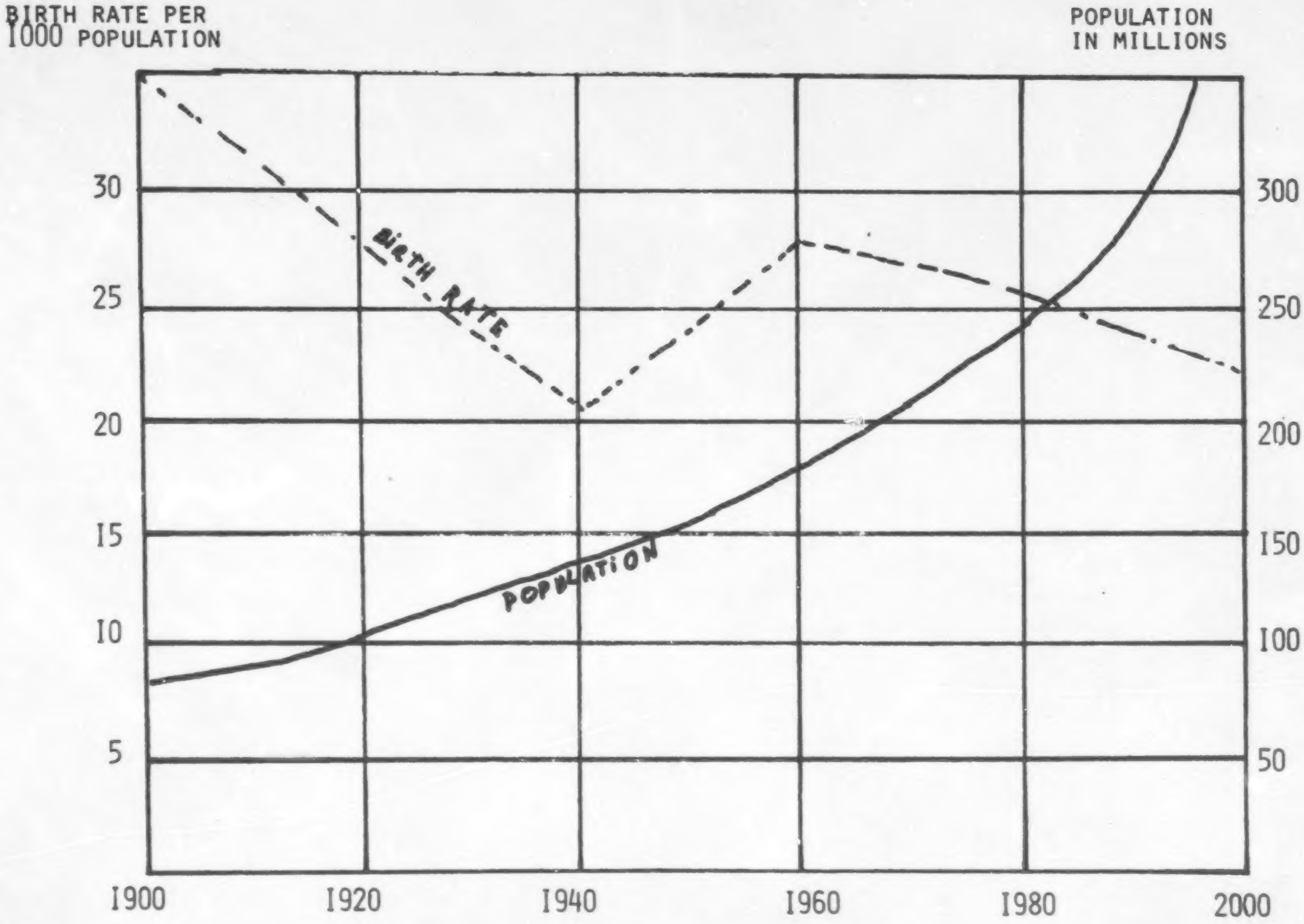
TERMS

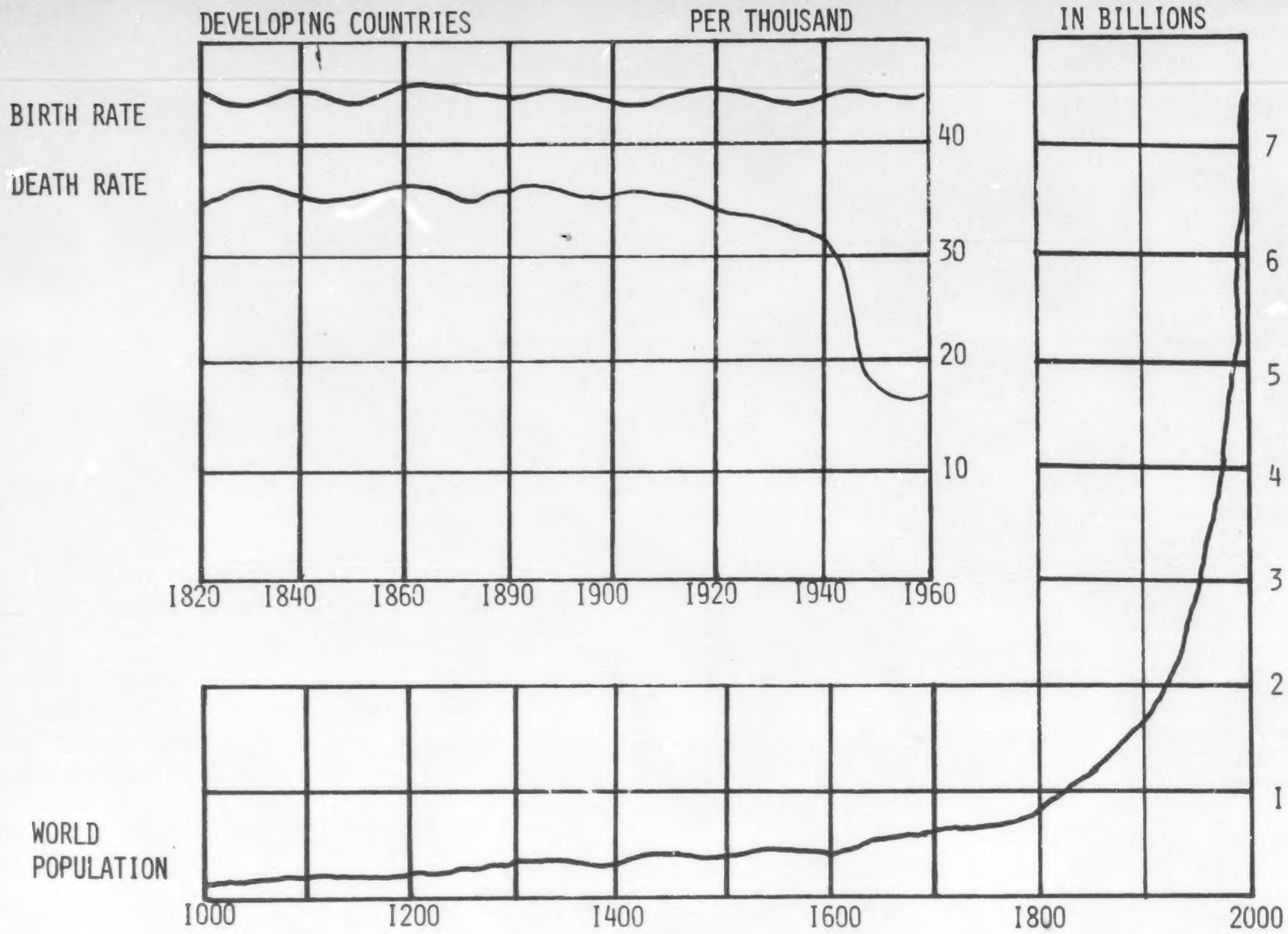
BIRTH RATE	THE NUMBER OF BIRTHS EACH YEAR PER 1000 PERSONS OF A POPULATION
DEATH RATE	THE NUMBER OF DEATHS EACH YEAR PER 1000 PERSONS OF A POPULATION
GROWTH RATE	THE BIRTH RATE MINUS THE DEATH RATE- INCREASES OR DECREASES IN A POPULATION DURING A YEAR
DEMOGRAPHIC TRANSITION	A CHANGE IN THE POPULATION DUE TO DECREASES OR INCREASES IN THE BIRTH RATE OR THE DEATH RATE
REPLACEMENT LEVEL	TWO CHILDREN PER COUPLE, ONE CHILD TO REPLACE EACH PARENT
ZERO POPULATION GROWTH	A BALANCE BETWEEN THE BIRTH RATE AND DEATH RATE, SO THAT EACH PERSON WHO DIES IS REPLACED BY ANOTHER

HISTORY OF POPULATION GROWTH

10,000 B.C. CAVEMEN	HUNTING AND FOOD GATHERING	Birth Rate - 5% Growth Rate - 2% Population = 5 Million
6,000 B.C. New Stone Age	AGRICULTURAL REVOLUTION - More stability to living conditions. Ways found to store food. Freed men from the constant search for food. The standards of living was raised. Urbanization occurred. Life expectancy was increased.	
1348 - 1379 A.D. The end of the Middle Ages - The Renaissance Began About 1400	POPULATION DROPPED IN EUROPE FROM 80 MILLION TO 60 MILLION	By the middle of the 14th century, society had expanded to the limits of its food supply provided by the available technology. Black Death and famine brought on from floods, droughts, insect plaques, and warfare caused 1/4 of the population to die. Declining markets and poor economic conditions
1620 A.D. PILGRIMS LANDED AT PLYMOUTH ROCK	POPULATION = 120 IN EUROPE 1/2 BILLION IN THE WORLD	Improvements in crops and farming techniques accompnaied a period of relative peace. The death rate was reduced.
1650 - 1750 A.D. AGE OF ABSOLUTISM GLORIOUS REVOLUTION - REIGN OF LOUIS XIV	POPULATION INCREASED ABOUT 40-75% GROWTH RATE = 3%	Man learned that many diseases were caused by "Germs". He began to learn about the cleanliness, Vaccines were discovered to prevent Diphtheria, Whooping Cough, Malaria, Cholera, Yellow Fever, and even Polio.
1750 - 1850 A.D. AMERICAN REVOLUTION FRENCH REVOLUTION	GROWTH RATE = 5% IN 1830, BEFORE THE CIVIL WAR, THE POPULATION = 1 BILLION	It had taken over 200 years for the population to Double.
1850 - 1950 A.D. AGE OF IMPERIALISM WORLD WAR I WORLD WAR II	GROWTH RATE = 1% POPULATION IN 1930= 2 BILLION	Demographic Transition accompanied the industrial revolution.

U.S. BIRTH RATE AND POPULATION GROWTH




DEVELOPING COUNTRIES
PER THOUSAND
IN BILLIONS
BIRTH RATE
DEATH RATE
40
30
20
10
1820
1840
1860
1890
1900
1920
1940
1960
7
6
5
4
3
2
1
WORLD POPULATION
1000
1200
1400
1600
1800
2000

FEWER BABIES DIE TODAY

1900	1969
X X X X X X X X	X X X X X X X X
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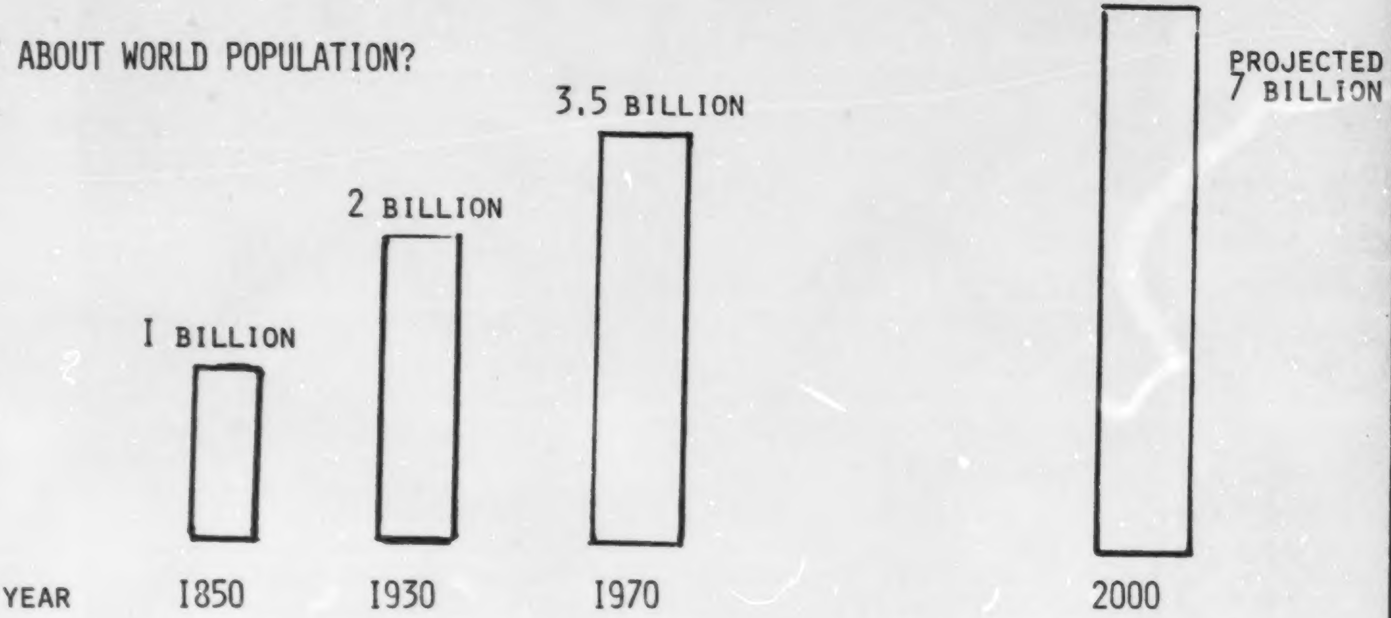
WORLD POPULATION

WHAT ABOUT WORLD POPULATION?

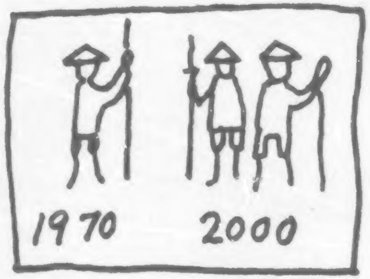


BY THE YEAR 2044 - 14 BILLION PEOPLE ? ? ?

1000 PEOPLE PER SQUARE MILE OF EARTH'S ARABLE - URBAN LAND

DOUBLING TIME

UNDERDEVELOPED COUNTRIES SUCH AS KENYA, INDONESIA, AND NIGERIA DOUBLE THEIR POPULATIONS EVERY 25 TO 30 YEARS



WHICH MEANS . . .

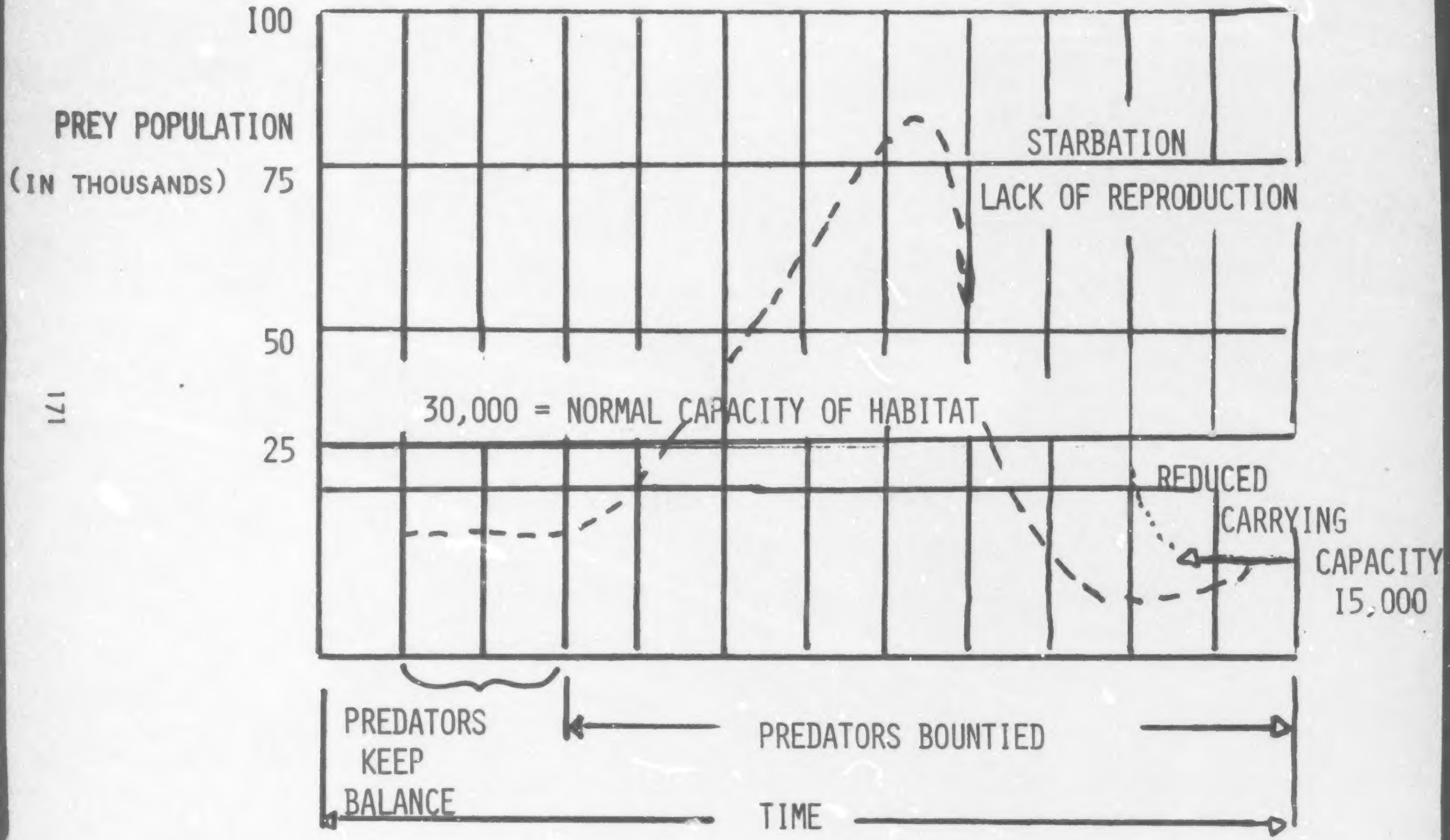
FOOD HAS TO BE DOUBLED

TRANSPORTATION MUST BE DOUBLED

DOCTORS, TEACHERS, ETC. MUST BE DOUBLED

DOUBLING TIME IN THE U.S. IS ABOUT 63 YEARS

PREY PREDATOR RELATIONSHIP



IF YOU WERE ON AN ADVISORY PANEL TO SUGGEST SOLUTIONS TO WORLD POPULATION, WHICH OF THE FOLLOWING WOULD YOU PROPOSE? WHY?

1. PASSING LAWS THAT LIMIT FAMILY SIZE.
2. RELYING ON EDUCATION TO MAKE PEOPLE AWARE OF THE PROBLEM.
3. ALLOWING POPULATION GROWTH TO CONTINUE AND RELYING ON NATURAL CHECKS SUCH AS DISEASE AND WAR.
4. PROPOSING YOUR OWN SOLUTION. SPECIFY.

OBJECTIVE:

To identify the methods by which various economic systems deal with infinite demands upon finite resources.

ACTIVITY 1:

Given below are quotes from the writings of various individuals or agencies, all of them dealing with energy-environment issues. The sources are listed first and then the group of quotes. Can you match authors with their words?

A. President Richard Nixon.

B. Atomic Energy Commission Chairman, Dixy Lee Ray

C. Consumer Advocate, Ralph Nader

D. Philip Abelson, U.S. Geological Survey

E. M. King Hubbert, U. S. Geological Survey

F. Atomic Energy Commission statement of Congressional Joint Committee

G. Massachusetts Institute of Technology Economist, M. A. Adelman

H. S. David Freeman, Director, Ford Foundation Energy Policy Project

I. Excerpt from September ATLANTIC editorial entitled, "Shall We Strip-Mine Iowa and Illinois to Air-Condition New York?"

J. Alvin Weinberg, Director, Oak Ridge National Laboratory

K. Senator Henry M. Jackson

_____1. "There are two things wrong with coal today. We can't mine it and we can't burn it."

_____2. "The choice we have to make is whether to continue using large quantities of nonhuman energy, at the same time conserving it and using engineering and technical skills to reduce environmental damage, or to return to something like a slave state, perhaps at a much lower population level, in which some people would have a perfectly satisfactory environment, but most people would live lives of misery and despair."

_____3. "We nuclear people have made a Faustian compact with society: we offer...an inexhaustible energy source...tainted with potential side effects that, if uncontrolled, could spell disaster."

_____4. "Unlimited resources of energy, however, do not imply an unlimited number of power plants. It is a true of power plants or automobiles as it is of biological populations that the earth cannot sustain any physical growth for more than a few tens of successive doublings. Because of this impossibility, the expotential rates of industrial and population growth that have prevailed during the past century and a half must soon cease. Although the forthcoming period of stability poses no insuperable physical or biological difficulties, it can hardly fail to force a major revision of those aspects of our current social and economic thinking that stem from the assumption that the growth rates that have characterized this temporary period can somehow be made permanent."

_____5. "The Atomic Energy Commission may not validly license a nuclear power plant for operation under the Atomic Energy Act or under its own regulations unless the plant possesses an ECCS (Emergency Core Cooling System) whose effectiveness is established. Continued operation of a nuclear power plant under the Act and Commission regulations requires assurance of an effective ECCS."

"The operating heads of the ECCS research programs at the Commission's primary safety research centers (Oak Ridge National Laboratory and Aerojet Nuclear Company) have stated that compliance with the IAC (Interim Acceptance Criteria) does not assure effectiveness of an ECCS and that there is insufficient scientific evidence to support the conclusion that an ECCS of current design (including those installed on the nuclear power plants which are the subject of this action) will, in fact, operate as intended."

_____6. "It is characteristic of a democratic form of government that major legislation is usually not enacted unless public opinion has crystalized in support of it. When as issue has dramatic appeal, far-reaching legislation is often enacted quickly. When issues are complex and nonemotional, the government moves slowly, if at all. An example of the latter attitude has been the government's treatment of the energy problem. Our national security, financial stability, and standard of living are at stake, but the federal response has not been commensurate with the need. Until recently, most of the talk about energy has been about the problems that will arise in 1985 or 2000. This has the effect of pigeonholding the matter. Who can sustain a high level of excitement about the year 1985?"

_____7. "The principal contribution of nuclear energy to meeting these goals will be through the production of electric power which, at this time, is only about 1/4 of total energy production. Therefore, while nuclear power now produces about 4% of the electricity in this country, less than 1% of the national energy consumption in 1972 was from nuclear sources. Looking ahead, the atom is expected to provide 10% of our total energy needs by 1985 and 25%-30% of total energy by the year 2000. If we consider only electric generation, then nuclear is expected to provide 50% - 60% by the end of this century."

_____8. "A major factor contributing to our present energy crisis is that the necessary research and development efforts which could have provided us with the technological options and capabilities we now need so desperately were not undertaken in the past."

_____9. "It is somewhat confusing that concern over nuclear plant safety has increased recently. Some explanation is undoubtedly to be found in sensationalist publications...but the most important reason appears to be the widespread lack of knowledge of both the excellent safety record of the nuclear power industry and

and the extreme efforts, unprecedented in any other industry, to assure that nuclear plants are designed, constructed, and operated with the highest attention to public and employee safety."

____10. "The world 'energy crisis' or 'energy shortage' is a fiction. It makes people accept higher oil prices as imposed by nature, when they are really fixed by collusion."

____11. "As America has become more prosperous and more heavily industrialized, our demands for energy have soared. Today, with 6% of the world's population, we consume almost a third of all the energy used in the world. Our energy demands have grown so rapidly that they now outstrip our available supples, and at our present rate of growth, our energy needs a dozen years from now will be nearly double what they were in 1970."...

"If we are to be certain that the forward thrust of our economy will not be hampered by insufficient energy supplies or by energy supplies that are prohibitively expensive, then we must not continue to be dependent on conventional forms of energy. We must instead make every effort through research and development to provide both alternative sources of energy and new technologies for producing and utilizing this energy."

Answers:

1-H; 2-I; 3-J; 4-E; 5-C; 6-D; 7-B; 8-K; 9-F; 10-G; 11-A

ACTIVITY 2:

To help students become aware of the energy problem:

A. Day 1: Ask students to take 5 minutes and prepare a list of items they would like to buy. Prepare a master list showing each item's energy consumption value.

Day 2: Give each student X amount of chips and a list of consumption rates. Explain that at the end of each 5 minute round he has to pay the energy collector for the energy his five items used during that round. Continue for five rounds of 5 minutes. The student who has the most chips remaining at the end of the game, WINS.

1. Can you draw any parallels to real life?
2. What is wrong with the situation?
3. What do you see as the purpose of the simulation?

B. Advertisement in The New York Times, "Every 7½ seconds a new American is born. He is a disarming little thing, but he begins to scream loudly in a voice that can be heard for seventy years. He is screaming for 26,000 tons of water, 21,000 gallons of gasoline, 10,150 pounds of meat, 28,000 pounds of milk and cream. 9,000 pounds of wheat, and great storehouses of all other foods, drinks, tobaccos. These are his lifetime demands of his country and its economy." To what degree are these "demand feedings" and to what degree are they "forced feedings." What are the implications?

C. Ask the class to list things they would buy if given an unlimited account. List these on board: (possible -- planes, sports cars, big houses, T.V.'s, clothes, stereo equipment).

1. What would prevent you from enjoying all these things?
2. Why did you choose these things?
3. What element do most of them have in common?

Discuss consequences of total energy depletion. This could be dramatized by cutting off air conditioner or heater, turning out lights, etc., (in newer schools).

What are the possible consequences of your choices?

D. SITUATION: Due to an embargo and the lack of oil from domestic production, Florida has been allocated X amount of oil. This oil is under the control of the Florida Energy Board.

METHOD: Have 5 students play the role of the energy board and divide the class into special interest groups such as: farmers, truckers, power companies, hospitals, fire and police, military, public transportation, each of whom demand part of the energy. Who gets it?

E. Illustrate in any way (drawing, poem, collage, narrative) how energy arrives at the lightswitch on your wall.

F. Topic: Energy in Florida. Have groups write a list of questions. Have them choose five of the questions they have written and do research to find the answer.

1. What are our sources of energy in Florida?
2. Where do we get it?
3. Are we running out?
4. What alternatives do we have?

G. Attitudes Inventory

1. Do you feel that we have an energy crisis?
2. Why or why not?
3. Do you personally do anything to conserve energy?
4. If so, what?
5. Do you encourage others to conserve energy?
6. Why or why not?
7. Do you think governmental restrictions should be imposed on the people in order to conserve energy?
8. If so, what restrictions?
9. How would you react to those restrictions?
10. How do you feel that most Americans would react, if any at all, to those restrictions?

11. Should there be severe punishment for violators of those restrictions?
12. Which of the following age groups do you fall in?
    (a) under 18 (b) 18-25 (c) 26-35 (d) 36-45 (e) over 45
13. Which of the following income brackets do you fall in?
    (a) $3,000-$6,000 (b) $7,000-$10,000 (c) $10,000-$20,000
    (d) over $20,000

H. The Newspaper - Propaganda Techniques

Select two newspaper/magazine articles on energy sources, etc. Cite examples of propaganda techniques (name calling, glittering generalities, band wagon, testimonials, card stacking, transfer, and plain folks) being used.

I. Cause and Effect

The statements in this exercise follow each other in cause and effect. Draw up four (4) statements of your own, using this same cause and effect relationship, but relate it to the energy crisis (i.e., how man's use of our resources in the name of "progress" has led to their depletion).

1. Nations desiring power (cause) needed to possess colonies (effect).
2. Nations possessing colonies (cause) needed large armies (effect).
3. Large armies and navies (cause) meant large military budgets (effect).
4. Large military budgets (cause) meant (what effect can you insert here?)

J. Decision Making

Assume that you must determine "the" energy alternative best suited for your state. Use the following procedure to arrive at your answer.

1. Define the problem
2. Plan a method of investigating the problem.
3. Gather and evaluate the information found.
4. Decide and act on implementing your findings.
5. Evaluate the decision made.

K. Interest/Pressure Groups

Find an environmentalist group, lobbyist or interest group in your State Capitol. Answer the following:

1. What are their goals?
2. What techniques do they use to influence politicians/educate the people?
3. How effective have they been in influencing legislation dealing with energy and/or the environment?

ACTIVITY 3:

Until modern times, high rates of reproduction were necessary to offset high mortality - especially infant mortality. In agricultural societies children were assets in the home and farm-centered economy. Also, before care of the aged became institutionalized, parents had to rely upon their children for care in their old age. Large numbers of children were advantageous. As a result of these factors and of short life expectancy, American women spent most of their adult lives bearing and rearing four or five children.

Long before the tradition of the large family disappeared, some couples had begun to adopt the small family pattern. As a result of declining mortality rates, a diminishing need for child labor in agriculture, increasing costs of raising a child in an industrialized urban society, and improved methods of fertility control, both the number of children desired and born declined.

Despite this trend, pronatalist pressures (those favoring childbearing) still exist. These include (1) the shaping of the young into sex-typed roles, with the boys pointed toward jobs and the girls toward home and motherhood; (2) discrimination against the working woman and especially the working mother; and (3) restrictions on higher education for women. Such forces are so pervasive that they are typically perceived as natural forces and not simply as cultural prescriptions.

As a way of illustrating these factors, a simple survey activity is suggested for use before classroom discussion. Use the questionnaire on the next page to measure the attitudes of your students.

In tabulating the results, look for the following patterns: Most persons will probably indicate plans for marriage and childbearing that are quite similar - revealing conditioning by cultural and social forces. Note those who do not expect the female to work after marriage: are there differences in male and female responses? Do the answers to the questions on number of children expected and number desired differ? If the same, mention the Commission's finding that 44 percent of all births from 1966 to 1970 were reported as unplanned and 15 percent as unwanted.

The questions on attitudes may suggest biases against nonmarriage and childless marriages as well as expectations that women will fit into the role of wife-homemaker-mother. Look for answers to question 15. If in agreement, the class does not reflect the Commission's recommendation for less regimented reproductive behavior. Such a recommendation was based on evidence that a non-growing population could be reached if, on the average, families had two children. This is not recommended as a standard for all to achieve.

In light of the results of the survey and after participants have had a chance to analyze and discuss their own attitudes, offer the following statement from the Commission for further comparison:

"The objective for American society should be to make the childbearing decision as free as possible of unintended societal pressures: It should not be to 'force' people to become parents in order to seem 'normal,' but to recognize that some people, and perhaps many, are not really suited to parenthood. We should strive for the ideal of diversity in which it would be equally honorable to marry or not, to be childless or not, to have one child or two or, for that matter, more. Our goal is one of less regimentation, not more."

1. Female ________ Male ________

2. Do you plan to marry? Yes ________ No ________

3. If yes, at what age do you plan to marry? Age ________________

4. If female and you plan to marry, do you plan to work after marriage? Yes ________ No ________

5. If male and you plan to marry, would you like your wife to work after marriage? Yes ________ No ________

6. If female how long will you work? If male, how long should your wife work after marriage? Years ________________

7. If you plan to have children, at what age would you expect to have your first child? Age ________________

8. How many children do you want to have? No. ________________

9. How many children do you expect to have? No. ________________

10. At what age would you expect to complete your childbearing? Age ________________

Do you agree or disagree with the following statements:	Agree	Disagree
11. Part of the fulfillment of everyone's life is in marriage	________	________
12. Part of the fulfillment of everyone's life is having children	________	________
13. A childless or a single-child family may have as fulfilling experiences as other families	________	________
14. If a couple has the number of children they want, but all are of one sex, they should keep trying for a baby of the other sex	________	________
15. All American couples should have two children in the interests of stopping population growth	________	________
16. Woman's place is in the home	________	________
17. After marriage and childbearing, women should continue working	________	________

	Agree	Disagree
18. Because most women marry and leave work when children are born, minor forms of job and pay discrimination must be expected	______	______
19. Unmarried women who are in their 40's and 50's are lonelier than unmarried men of the same age	______	______

ACTIVITY 4:

For many years the concept of economic growth has been freely accepted by government, labor, business, and Chambers of Commerce. There has been an attempt to equate quantity with quality of life. Consequently, many cities are suffering from years of unplanned growth. This ad below could be used as a springboard for discussing the problems that may result from rapid and unplanned growth. Reproduce and distribute this ad, or ask students to find others in local newspapers or magazines

FROM EVERY PART OF THE COUNTRY
PEOPLE ARE COMING TO MOPLIN

A year of progress and the forecast of greater improvement are yours in Moplin. For manpower, raw materials and transportation, Moplin has been the state's leading growth center during the last decade. The city's output has doubled in the last year alone.

We can offer you both financial assistance and tax benefits on your investments in new or increased production facilities especially those oriented to research. Both private and public funds are available for up to 100% financing on new construction, in some cases. In addition, the city offers special business tax credits for new operations in low-income sections of the city.

More and more companies such as Kellogg, Xerox, GM, U.S. Steel, Ralston Purina, and Reynolds Metal are choosing Moplin as the site for their regional center. They have found what they were looking for and you can too.

For more information, complete the attached form and mail today.

- -

Commissioner H.T. Waxen
Moplin Dept. of Commerce, 2-B First
Street
Moplin, O.K. 122987

Name	City
Title Firm	State Zip
Address	

Questions:

1. What do you think the purpose of this ad is?
2. Do any of the words or phrases relate to population growth? population distribution? Underline those that do.
3. What does the phrase "growth for growth's sake" mean to you?
4. Do you think that restrictions should be placed on future economic growth? Why or why not?

ACTIVITY 5:

Twenty-nine states in the United States face competition for the use of coastal wetlands and numerous development options. Land-use competition is not restricted to coastal area, and as President Nixon stated in early 1973, "balancing the need for development and growth with the need to preserve and enhance our environment has become a major issue of our time." The article below reflects some of these conflicting issues.

Choose a spokesman for each of the following interest groups and have students or participants outline the policies and demands of each: conservationists, builder/developers, and industrialists.

DELAWARE WETLANDS AT CROSSROADS

With Refineries Halted, Decision Now One of People or Nature

by George C. Wilson
Washington Post Staff
Writer

REHOBOTH, Del.- From 1,000 feet up, it becomes clear what the argument is all about. The light airplane, hanging in the stiff headwind, looks down on the choices Delaware and other coastal states have to make.

There, on the point of sands reaching into Indian River Bay behind the ocean beach running between Rehoboth and Bethany, is one option. It is a summer city of mobile homes rising out of the marsh.

Dredges have dug curving paths through the grassy wetland, leaving water-filled lagoons behind them. The sand sucked up has been piled on to the banks of the new lagoons, forming the foundation for trailer homes.

Another option for those planning Delaware's future comes into view as the plane flies north along the coast, beyond Rehoboth, gliding low over wetlands set aside by the state for ducks and fish - not for people.

At one salt-water pond deep in the isolated wetlands north of Dover, Canada geese paddle away unconcernedly until the noise of the plane's engine reaches them. Then they fly briefly out of the water and plop down again on the far side of the lead-colored pond hidden among the acres of brown cord grass.

And, finally, near the northern border of the state at Delaware City, the plane reaches the third option - intensive development of the wetlands. It skirts around the stacks of the Getty oil refinery processing the crude oil pumped out of tankers sailing into Delaware Bay.

The three locations covered by the flight symbolize the policies of no growth, moderate growth and intensive growth. The need to protect the fragile chain of life for ducks and fish figures in the no growth argument; the population's yearning for waterfront places to spend its increasing amount of leisure time adds thrust to the moderate growth possibility, and concern about the "energy crisis" buttresses the case for intensive development along the coast - like building more oil refineries.

Questions:

What are the major conflicting issues? Is it possible to satisfy the demands of all three interest groups?

What are the costs involved for each of the following:

- wildlife and the natural environment
- vacationers wanting an inexpensive weekend retreat
- the local job market
- the economic prosperity of the community
- the need for increasing energy sources

Who should establish and regulate development policy? Why?

What has your community done to encourage critical, long-run land-use planning?

ACTIVITY 6:

Responsible parenthood means that parents have some understanding of the implication of their reproductive decisions for themselves and their children. While the benefits and rewards of children are well known, many people fail to recognize the emotional and financial costs involved. For example, direct costs over raising a child from birth through high school or college. In addition to these direct costs, one parent - usually the woman - will tend to spend more time at home, thus giving up an income which she might otherwise have earned.

Information on the costs to the family of raising a child is an important part of education for parenthood. With some idea of the financial demands of children, parents can plan ahead and be better prepared to provide the kind of life they want for their children.

Yet other costs are involved when couples have children before they want them. Recent research has shown a high level of unplanned pregnancies and unwanted births in the United States. According to estimates of the Office of Population Research at Princeton University, which conducted the 1970 National Fertility Study, 44 percent of all birth to currently married women during the five years between 1966 and 1970 were unplanned; 15 percent were reported by the parents as having never been wanted. Theoretically this many unwanted births suggests that 2.65

million of the birth occurring in those five years would not have occurred had perfect fertility control been available.

The costs of such a high incidence of unplanned reproduction are many - financial, social, psychological, and health. Family budgets may be seriously strained by an unexpected birth. Those families who can least afford this kind of burden most often face it.

More than half the states have laws that prohibit or restrict the sale, distribution, advertising, and display of contraceptives. The Commission found, for example, that 22 states prohibit the sale of all or some contraceptives; 23 states prohibit commercial advertising and display of contraceptives or information about them.

It is difficult to interpret these anti-birth control laws because enforcement is uneven; and in some states, court decisions have changed the letter of the law.

To give students a better idea of what impediments actually exist in their own state and community, suggest an inventory. Ask students to investigate the following:

1. The statutes in their state that limit access to contraceptive information, procedures, and supplies.
2. Attempts to change the laws or circumvent them. (For example, does the college health service provide birth control services to minors despite the state laws? With what consequences?

Resources for research on this question could be the law sections of various libraries, neighborhood pharmacists, physicians, and local agencies, such as Planned Parenthood and Zero Population Growth chapters.

ACTIVITY 7:

To help pupils realize the importance of trees and their products in our economy, contact your local forester. Ask him to visit your class on a certain day to discuss his work.

On the day following the forester's visit, lead the class in a discussion of the previous day's activities; you might ask:

1. Can someone tell me something you learned yesterday about the use of trees?
2. How can we be sure there will always be enough trees to supply the products we want?
3. Why did man first cut down trees?
4. In what ways do we destroy valuable forests today?
5. Why should we be concerned with this problem?
6. Can you think of any products other than paper which came from trees?

Have the students make lists of as many products as they can think of which come from trees. Allow 5 - 10 minutes for this. Then have several of the lists read.

Extending the Concept: Have the students close their eyes. Tell them to imagine the classroom without any items which came from trees. Tell them to raise their hands when they have thought of tree items which would be missing. Call on several students for their items. Then ask:

1. Is it possible for us to get along without products from trees?
2. Is there any danger of our running out of trees?
3. What can we do about this?
4. Is our city, state, or nation doing anything to stop the depletion of our forests? Why?

Have the students find magazine and newspaper articles about trees (conservation, forest fires, planting trees, paper industry relating to trees, etc.). Have them bring the articles to class. Allow time for reading the articles and discussion. As this lesson is designed to make the student aware of the value of tree products to us, any project which the teacher might use to enhance this idea would be useful. Perhaps you could find an area of land in the community that is barren; contact the owner and suggest tree planting. The class might volunteer to help in setting out the seedlings.

Instructional Materials:

Pamphlets - "Making Paper from Trees" K15 - USFS
"How the Forests Serve Us" 025 - USFS

Posters - "What we Get from Trees" D5 - USFS
"What We get from the Forest Lands" D9 - USFS

Films - The Forest, color, 29 min. USDA

ACTIVITY 8:

To help pupils understand the problems facing man in mountainous areas between the 35th and 45th parallels, and to recognize man's tragic failure to provide for future generations by conserving the natural resources which were the basis of his prosperity and progress, tell, read, or use a film of the myth Persephone (Latin: Proserpina).

1. What does Proserpina represent?
2. Who was her mother?
3. In what latitudinal zone did they live?
4. What kind of landform is described in the myth?
5. Why could Pluto give his wife all the riches of the earth?

Look at the physical map of the Balkan Peninsula. From the latitudes, landforms, and water areas, deduce the answer to the following questions:

1. Why did nomadic shepherds migrate from the vast Caspian grasslands into the small seaward-facing valleys of the Balkans?

2. Why was the soil of these valleys unable to support large populations?
3. Why did groups move farther and farther down the peninsula?
4. Why did each valley settlement develop its own form of city- state?
5. How did the landform affect attempts at political union?
6. Why did the city-states of Greece develop trade with the Mediterranean countries and establish overseas colonies?
7. What conditions in Greece explain why farming was based upon herding and the growing of wheat, olives, and grapes?
8. Why did the Greeks develop the gable roof?
9. Why were their temples and public buildings built of marble?
10. What geographical factors helped to maintain healthful vigor in these peoples?

11 Why did they choose a mountain for the home of their greatest god?

12. What did their gods represent?
13. Why were these people aware of the importance of all of nature's forms?

Look at the rainfall map of the world.

1. What annual rainfall is shown for the Balkans? How does this compare with the rainfall in our area?
2. Where are the mountain/hill forms in our country? Are there cultivated fields on the slopes? What kinds of crops?
3. Why does our country have forests on the slopes?
4. What is meant by "contour" plowing? What is its purpose? Locate some examples of contour plowing in our country.
5. Where do our farmers plant cover crops, grasses, legumes, clovers? Why?

Instructional Materials:
Myths of Greece and Rome (There are many translations/adaptations. Take your choice.)
Physical map of Eurasia
Rainfall map of the world

ACTIVITY 9:

To help students understand that in order for a nation or civilization to remain strong, it must conserve its natural resources, obtain pictures of Roman ruins (Colosseum, Forum, etc.). Have a student who draws well (or do them yourself) sketch several pictures of famous U.S. buildings in ruins (White House, Lincoln Memorial, etc.). Show both groups of pictures to the class and ask:

1. Why are the Roman buildings in ruins?
2. How could such a great empire fall?
3. Why have I shown the U.S. buildings in ruins?

4. Could this possibly happen?
5. What factors might lead to this condition?
6. Could natural resources have influenced either situation?

Here the students may not be able to answer this question. Continue with the textbook material on the fall of Rome and return to developing the concept when the unit is completed. This lesson could be used to introduce the fall of the Roman Empire or some other civilization which has fallen partly because of misuse of natural resources.

Show the pictures used earlier to help answer the following questions:

1. What effect did natural resources have on the fall of Rome
2. Could this problem have been overcome?
3. Why did the people not take measures to eliminate the problem?
4. Does the U.S. have a similar problem today?
5. Are we doing anything to eliminate the problem?

Is our government doing anything to protect (or conserve) our natural resources? Give examples.

Have students name the federal, state, and local agencies to which one can go or write for information and help in conserving our natural resources. Divide the class for writing or visiting these agencies to gather the needed information. Use materials found for discussion, panel, or group reports.

Instructional Materials: Texts
Supplemental material
Pictures
Sketches, etc.

ACTIVITY 10:

Give students a case study (see Reading I) which describes a social, political problem that originates from the needs of the environment. Through class discussion Reading I is reviewed. Teacher may use the following questions as a guide:

1. What is the political problem in the story you read for homework? Explain how the situation is dysfunctional to the political system.

Answer: Answers might vary, but all answers should point out that the case describes a conflict or dis-equilibrium. This is turn interference with the political system fulfilling its necessary functions.

2. (After giving the students a definition for faction, a party in a conflict, ask) Which are the factions in this conflict?

Answer: Developers vs Environmentalists

3. What are different alternative courses of action that might resolve this conflict?

Answer: Varying - teacher should list these on board.

4. Which alternative do you think is best?

Answer: Allow students to free-flow their ideas through answers which will vary and then teacher might play "devil's advocate." Teacher is introduced "talking" as an alternative if students have not.

Teacher proceeds to lead students to analyze one of the alternatives given in discussion. He does this by first telling students to suppose one of the alternatives were put into effect. The teacher has students suggest all the positive results that will come from the alternative course of action. Then the students suggest all the negative results that will happen. These results should also be recorded on the board. Discussion should follow as to the wisdom of implementing this alternative using the results.

Teacher next sets up for role playing exercise. This class is to role-play a state cabinet meeting that is the process of resolving a conflict. The teacher must fill the following roles with students:

1 Governor (must be a responsible student)
4 Cabinet members
1 to 3 member delegation representing Developers
1 to 3 member delegation representing supporters of protecting the Wetlands
1 to 3 member delegation representing supporters state buying land

Each role has a role description. These should be handed out to the appropriate students.

Homework: Students are to read their role descriptions and do the exercise that has them prepare their positions.

Teacher sets up for role playing activity. It is best to have the "Cabinet" in front of class and allow the witnesses to come before it. "Governor" should lead the proceedings by introducing the topic for discussion and calling witnesses.

With 5 minutes left, either the "Governor" or teacher breaks the proceedings and announces that the next day the class will go on a field trip to investigate the area under discussion.

The following activities can be viewed as optional. The teacher can do one or both of the following. The purpose is to add to the sensitivity of students the importance and complexity of this conflict.

Students Go Out on A Field Trip - On this trip, students are to complete the handout - "The Gateway Wetlands." The teacher might feel that the handout is too technical and might want to simplify it. The assignment can also be in cooperation with a related science study. A science teacher should be used to direct the field trip. If a field trip is impossible, the showing of the film "The Salt Marsh, A Question of Values" (E.B.F.)

Bring in people in the community who are involved with the Gateway controversy or the development controversy in the county. People from the Developers group and the environmentalists can be used. These speakers can be used in a panel format or individually. The purpose is to present an equal presentation for both sides of the controversy.

Students complete their role playing activities, with "Governor" chairing the proceedings.

When role playing has been completed, each student fills in a value sheet which demonstrates the student's initial position on the conflict. Teacher collects these sheets and evaluates them.

Materials - Reading 1
Role playing descriptions
The Gateway Wetlands
Handout: Value Sheet

Reading #1:

GATEWAY: To Develop or Not

In Pinellas County, an ongoing political problem keeps surfacing. It deals with one of the last natural coastlines on the peninsula. The controversy is referred to as the Gateway development. Simply stated, the political problem is: Should the Gateway area be allowed to be developed.

Development is the building of homes, parks, stores, etc. Pinellas, because if its rapid population increases of the past decades, has experienced expansive development. Development, of course, changes the natural environment. Many natural processes are destroyed. In the case of the Gateway area, wetlands (transitory section that divides the land from the bay) would be disturbed if not destroyed. Most wetlands in Pinellas have lost their vegetation and sea walls stand where they once thrived because of development. The Gateway area is the largest of the few wetlands left in the county.

Wetlands offer many advantages to man. One is that the area serves as a buffer between oncoming high tides during storms, minimizing the chances for flooding. Probably the most important contribution of wetlands to man is that many commercial sea animals spawn in the brackish water of the wetlands. There are many other advantages, too numerous to list here. But, in any event, the development of wetlands is costly in terms of these lost advantages, as well as profitable.

In the case of Gateway, several attemots have been made to develop the area. The most ambitious project proposed was to build an amusement park-trade complex. This was supported by St. Petersburg officials, such as former May Wedding. The project was proposed by Suncoast International, a developing firm. As part of the plan, pointing out that no one knew what the effect of the project would have to the local environment, the city of St. Petersburg was going to annex the areas and rezone it (it is presently zoned for agricultural use). Local environmentalists objected to the plan, pointing out that no one knew what effect the project would have to the local environment. The project at this time seems dead, but the attractiveness of the area for potential development is still admired by those who would want to make a profitable dollar from some sort of project.

And so one might argue it should be attractive. Surely the idea of a man investing on some resource, in this case land, to make a profit, if a basic idea of our economy. The people involved with this land, who own the land, feel they have certain rights to it. They pay taxes on that land, high ones, and would like to see their forethought and ingenuity pay off. After all, isn't that what America is all about?

THE TAKING ISSUE

One solution to the controversy of the Gateway lies in a strategy known as "taking." Taking is a simple policy in which the government regulates what a person does with his land. For example, one way to prevent anyone from developing Gateway is to deny any building permits to be issued for the area. The reason it is called "taking" is because the government is limiting the use of property; therefore taking the property from the owner. This strategy might cause some legal problems. The United States Constitution states in the Fifth Amendment:

...nor shall private property be taken for public use without just compensation. Just compensation is usually considered market price. In the case of the Gateway, market price is $15 million.

There have been many court cases in which people have sued local governments, charging that these governments passed laws that regulate the use of their private land. Their suits saw the action as "taking" the land and that they should be compensated (paid) for their land. In many cases the courts have decided that the government had the right to regulate the land without paying. A study of such cases stated: "It is an American fable or myth that a man can use his land any way he pleases regardless of his neighbors".

In other cases the court has found in favor of the land owners. In 1922 the Supreme Court established a loose guideline that should be followed in such cases. Justice Holmes wrote in the majority opinion of Pennsylvania Coal Company vs Mahon case that "The general rule at least is, that while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a "taking". How this guideline applies to the Wetlands, and more specifically to the Gateway, is a matter of interpretation. Until a court decides though, regulation through the denial of permits might be a way to prevent development.

Tomorrow the class will discuss this case. It will be helpful if the students can answer these questions:

1. How is the Gateway area development a political problem?
2. Who are the political adversaries in this political problem?
3. Summarize the positions of both sides of the conflict.

4. Has any governmental body shown a preference in this conflict? If so, which governmental agency is it and what side did they prefer?

5. How can the "taking" issue be used in the Gateway question?

ROLE PLAYING DESCRIPTIONS

Tomorrow you will be role playing a state cabinet meeting, that is, you will pretend that the cabinet is going to convene and decide if the state should buy the Gateway area. The cabinet is made up of elected officials. Each official is head of a different department of the executive branch of state government and it also has the governor at its head. For example, members of the cabinet include the Superintendend of Education, head of the State Department of Education; the State Attorney General, head of the State Department of Justice, and so on. It is much like the cabinet under the President in the federal government except for two important differences.

1. The states usually vote for their cabinet members. Whereas the President appoints his.

2. State cabinets usually have to vote on how state money that has been appropriated by the legislature, will be spent, whereas the President can have the last say in the Federal system.

In our classroom "cabinet" meeting, the following rules will be acted out by students who are chosen by the teacher:

Governor
Cabinet Member #1
Cabinet Member #2
Cabinet Member #3
Cabinet Member #4

Members of a delegation representing developers
Members of a delegation representing the protection of the wetlands
Members of a delegation representing the position that the state buy the land
Audience

You are to read the following role description that pertains to the role the teacher has given you. Then you are to do the exercise that follows the descriptions in preparation for the role playing activity. For the activity to be successful, each participant must really take on his role.

Governor: You have a very responsible position. You must chair the cabinet meeting. That is, you call the people who will appear before the cabinet. Below are the other witnesses; make a list of the witnesses in the order you are going to call them. You are also responsible to maintain order and call the other cabinet members when it is time for them to ask questions of the witnesses. Of course, you get to ask questions, also...

One more word about procedure. When witnesses are called they should be given five minutes to present their case. Then each of the cabinet members, including yourself, should have about three minutes to ask questions if there are any.

As for your role, you have been a popular governor and there has been some talk of your running for President or Vice-President of the country. You might be willing to go along with that effort and even help it along.

Cabinet Member #1: You were elected from a very urban area. You have seen what fast development can do to the environment. You have been a strong supporter on environmental causes.

Cabinet Member #2: You are from an area that is developing very rapidly, like Pinellas County. Developers contributed heavily in your last campaign. You are counting on their contributions in the future.

Cabinet Member #3: You consider yourself a friend of the working man. You are for spending tax money that will be helpful in creating jobs. You are against those things that would discourage jobs or hurt the workingman.

Cabinet Member #4: You are very indebted to environmentalist groups. They supported your candidacy in the last election all around the state. While you are not necessarily a strong proponent of environmental issues, your opponent was considered a strong anit-environmentalist. Therefore, these groups supported you. Come next election it would be nice to have that support again.

Member of the delegation representing developers: The area is an attractive one. If developed people would like to live there. They will be willing to pay large fees. It would mean large profits for the developers involved. It would also mean a lot of jobs for construction workers. Finally, it would mean a lot of money in the Pinellas economy, which would benefit everyone.

Member of the delegation representing the protection of the wetlands: You are a member of a group that is convinced that the wetlands case is a typical example of how the environment will be lost for future generations. You realize that the benefits and beauty of nature will not be lost because of one action, but through a succession of abuses that little by little will destroy the environment. The only way to stop this trend is to fight each time someone proposes to do unnecessary harm to the natural setting. In the case of the Gateway, Pinellas is already over-developed and the benefits of the wetlands as they are surely outweigh the benefits of one more development.

Member of the delegation that supports the state buying the land: You think that a good resolution to the conflict is for the state to buy the wetlands. This will cost the taxpayer $15 million.

Audience: You pick an alternative (one of the above positions or one of your own). Then do the assignment that follows:

Assignment: You are to write an alternative to solve the problem between environmentalist and developers. Your alternative should follow logically from your role description. Then you are to list all the positive and negative results that would be put into effect if your alternative would be used (you can guess at this).

THE GATEWAY WETLANDS

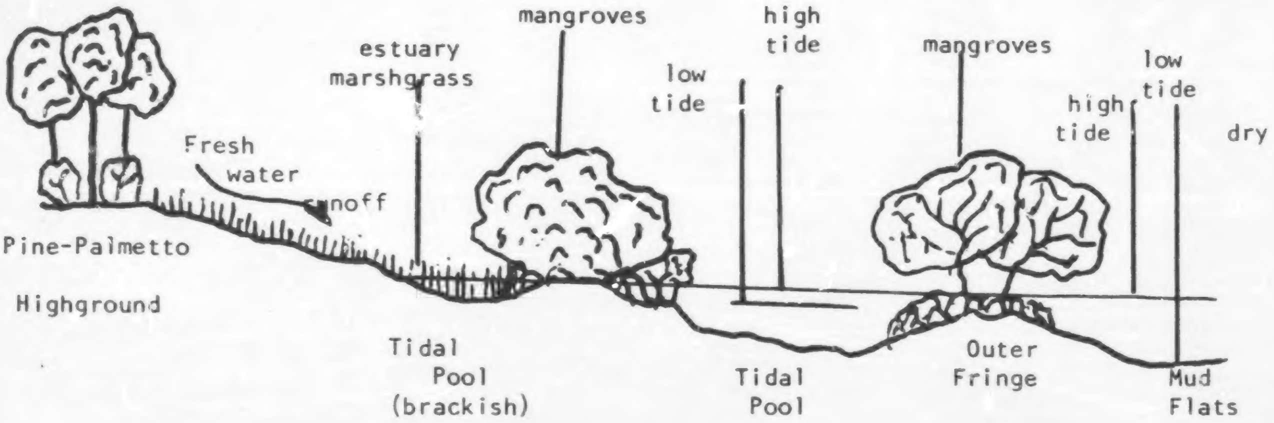
A unique natural community survives in the wetlands which curve along the northern shores of St. Petersburg. A strip of uninterrupted salt marsh and mangrove swampland extends from the I-75 approach to the Howard Frankland Bridge, west to the backyard of the Clearwater Airport. This undeveloped land skirting Tampa Bay contains about one thousand acres of relatively wild and undisturbed land.

This shoreline consists of a broken chain of tiny mangrove islands, mud flats, and marsh lands, and represents one of the great natural resources of Florida. These mangrove salt marshes are responsible for the deep peat beds that form a protective covering along the coasts of southern and west Florida. They help to reduce the effects of violent hurricanes, and protect the shoreline from erosion by storm tides. Salt marshes have some capacity to handle "degradable" wastes and pollution. They act as natural filters and digesters provided that the inflor of such pollution is slow enough to be absorbed by the system.

In tropical or sub-tropical climates, marshy coastal areas often contain two species of mangrove trees. These hearty plants are salt-tolerant and grow along sheltered gulf or bay shorelines. The mangrove is called "the island builder". Its prop roots not only provide a surface for the attachment of marine life such as oysters, but their leggy supporting roots entangle and trap floating organic debris, mud and sand until a small mound of bottom material is built up beneath the protection of the roots. Gradually, as more mangroves anchor and take root in the area, more and more bottom material mounts up until the roots are surrounded by a rising foothold of richly-stocked mud and sand. In the absence of severe tides and storms, eventually islands appear beneath the hearty mangroves to form a fringe of protection along the low, muddy beaches.

It is behind these natural barriers of small islands that a special tidal zone develops - intermediate between the open water and the thick beds of marsh grass further inland. Fresh water running off the land meets and mixes with the salty tidal water to create large, sheltered pools of water which have a lower salt content. This area of brackish water is called an estuary. This unique habitat contains the greatest diversity of plants and animals found in any one habitat on earth. Both fresh water and salt water plants can live here with land animals and marine animals. Scientists call estuaries the "Cradle of the Sea" -- a nursery grounds for young plants and animals.

This diagram illustrates a physical profile of the Gateway Wetlands.



Where does the fresh water come from that enters the tidal pools along the shore? These mangrove and marsh grass areas are alternately wet and dry with the tides from the sea side, however, the more inland portions of the marsh contain freshwater which drains from the high ground behind the lowlands. The amount of fresh water draining into Tampa Bay is, of course, especially high during the heavy rains of summer. The Gateway marsh received fresh water as "runoff" from higher ground back in the developed areas of St. Petersburg. Fresh water drains down from Saw Grass Lake in Pinellas Park, from principle city drainage ditches and storm sewers, and as sheet runoff. The major outflow of fresh water into the Bay occurs near the junction of Roosevelt Boulevard and I-75.

Characteristically, estuaries tend to be more productive than either the sea on one side or the fresh water drainage on the other. An estuary is a nutrient trap - a self-enriching system. The productivity of an acre of marsh land is found to be 4.8 tons per year. This is twice as productive as an acre sized cornfield. In the marshy areas inland from the mangrove fringe, all of the plant and other organic matter accumulates during high water, and then decays when it is exposed during dry periods. This dead and decaying plant material is called Detritus and contains a wide spectrum of chemicals and nutrients. Microscopic plants called Diatoms and many varieties of fungi and bacteria digest and break down the thick mat of Detritus, thus releasing the valuable nutrients into the calm tide pools. The "rich soup" is food - a basic mainstay for the simplest creatures of the food web of the marsh lands. Who eats the Detritus? The answer to that question reveals just one relationship among the inhabitants of the estuary: just one food chain of the complex web.

Detritus is: eaten by Bacteria and Fungi; Fiddler Crab; Fish (juvenile) and Great Blue Heron.

In the waters fish are abundant in the shallows where, as juveniles, they feed on the insects, organic debris or algae. Some of the specimens found there are:

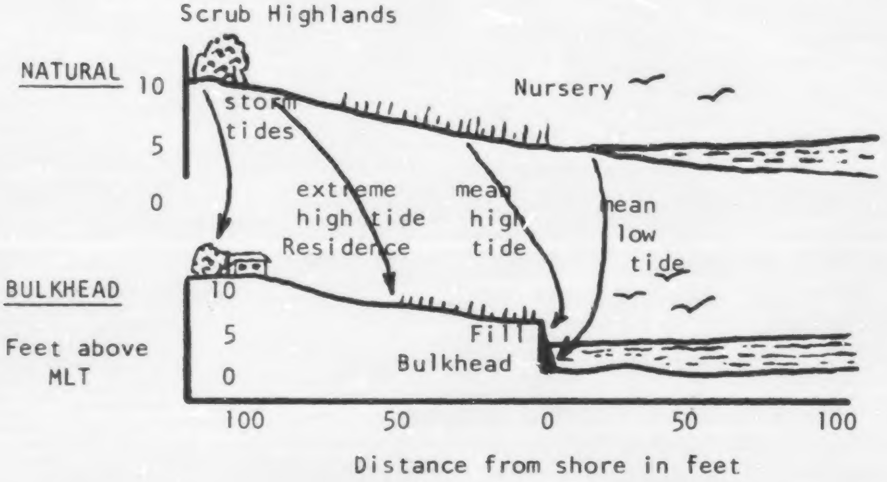
Flagfish Mackerel Birdfish Catfish Spotted Sea Trout Drum
Anchovie Menhaden Kilifish Sheepshead Mullet Grunt Flounder

Other marine animals are the Squid, Shrimp, Oysters, Clams and Crabs. Upon maturing, these species go further out to sea and become part of our commercial and game fisheries.

Here is a list of land and air animals which make these wetlands their home, their feeding and nesting grounds; Sea gulls, Egrets, Herons, Sandpipers and numerous shore birds, land crabs, Turtles, Raccoon, Opossum, frogs, songbirds, Wood Storks, Ibis, Pelicans, and numerous rodents and marsh rabbits.

Marshlands with this abundance of variety can hardly be called "wasteland". In terms of the production of seafood and as a "Link to the Sun", this community is priceless and irreplaceable. In the salt wetlands Nature has created her most efficient self-fueling machine which constantly contributes life to the sea.

What happens when these lands are filled, bulkheaded and developed? The following excerpt taken from Eugene T. Odum's Fundamentals of Ecology may explain what is lost.



"Bulkheading destroys the most important part of the estuarine 'nursery ground' and encourages the building of housing developments that are vunerable to hurricanes and other storms. This is only one of the numerous kinds of modification undertaken in the name of 'progress' and 'development' which unwittingly destroys natural resources often at great cost to taxpayers, since most such operations are not paid for 'by private' developers but by state or federal funds from the 'rivers and harbors pork barrel political system'."

"The potential high productivity of estuaries has often not been appreciated by man, who has frequently classed them as 'worthless' areas suitable only for the dumping of waste materials or useful only if drained or filled and converted to terrestrial use. The diagram illustrates a particularly unfortunate modification that destroys the most productive zone and creates residential property that is vulnerable to storms. When the doubled costs (i.e., the original construction cost and subsequent cost of maintenance and repair of storm damage paid by the taxpayer) of such changes and the high potential of the unmodified estuary for seafood protein and waste treatment are considered, it is clear that utilization in the natural state is preferable. - Many states are enacting legislation to preserve this 'best and highest use'."

Eugene T. Odum

The Gateway Wetlands - Reviewing the Situation:

1. What is the value of mangroves to the Gateway Wetlands?
2. Why are mangroves such successful pioneer plants?
3. What is Detritus? What eats it?
4. Explain why an estuary can be called the "Cradle of the Sea."
5. List five commercially important animals which spend part of their lifetime in the estuaries of the wetlands.
6. How does man fit into the ecosystem of marshlands?
7. If the municipal run-off of water from St. Petersburg suddenly became heavily polluted with oil and raw sewage, what effect would this type of input have on the ecosystem of the estuary?
8. Do you think this threat exists for the Gateway area? What measures could prevent such a disaster for the wetlands?
9. Do you think Tampa Bay "needs" the Gateway area as an estuary? Explain.
10. What do you think are the chances for survival for the Gateway Wetlands even if this area is not developed?

Value Sheet

In the last several days you have been introduced to a local environment problem. In the next few weeks you will look at practical ways to engage in political conflicts such as this one. But, before you do get involved politically, you need a political goal. That is, you must now decide which alternative course of action you think is worth pursuing and seriously consider why you think it is the best.

Briefly describe the course of action you think is best in solving the Gateway controversy.

List all the positive results if your alternative was put into effect.

List all the negative results if your alternative was put into effect.

Explain how the positive effects outweigh the negative effects, at least more so than any other possible alternative.

ACTIVITY 11:

Students are presented with two piles of chance cards. One pile represents cash values from 5¢ to one million dollars all of which (theoretically) could be kept by the student. The other pile contains environmental values which range from 5 bottle caps disappearing, to the saving of Lake Erie. Each students gets 3 chances to pick cards. After all the students have picked, tally the results to show how many money cards were picked as opposed to environmental cards. The purpose of this activity is not to predict a specific cause for environmental disaster, but rather to identify the "human nature" profile which will allow such a crisis to occur. It should be pointed out that greed is not a term used to define any Floridians, but rather it is a worldly term and should be kept in that scope.

1. Do you think man's monetary interests will make our environment unsuitable for human habitation? (Remember, that this doesn't need to be something super dramatic, but rather could be as simple as running out of water, polluting water beyond our ability to use it, losing our soil to erosion, air pollution such as that in Denora, Pennsylvania that killed several, or overpopulation relative to our food sources.)

2. Is there any way that environmental losses can be computed in economic terms that will make industrialists and developers listen?

3. Remember, that environmental degradation can be localized and won't be a problem for all people. Do you think the greedy will sacrafice some of their monetary gains for the benefit of others? Are there any true cases of this in today's world?

ACTIVITY 12:

Background Information:

Giant Power Corporation serves an area of which TACO County is part. The county has been growing quite rapidly in the past few years. In addition to permanent residents moving into the area requesting electricity, many tourists spend the winter months residing as semi-permanent residents.

TACO County has been and still is basically a rural county with thoroughbred horse farming and ranching activities as major revenue source. It does have some light industry with the Chamber of Commerce working hard to make the county attractive to new industries.

Since the 1973 oil embargo, electric rates have escalated dramatically. Many residents, therefore, found ways to cut back electric usage so that Giant Power Corporation did not sell as much electricity as it was anticipating. Because of this, according to Giant Power Corporation, it fears it will not be able to continue showing the 9% profit the Public Service Commission allows it.

Therefore, Giant Power Corporation has requested the Public Service Commission to:

1. Raise the electrical rates for private homeowners.
2. Lower rates for commercial usage.
3. Increase the refundable private user deposit to $75 for new customers.
4. Increase the reconnect fee to $60.
5. Charge customers $50 to have their meter checked if no Giant Power Corporation meter error is found.

The role playing situation is to simulate the hearing that was held. The roles are:

1. Three Public Service Commission Members - Three students serve as members of the Public Service Commission. They select a chairman and conduct the hearing. They question individuals and ask for comments from interested parties. When the hearing is complete they decide their recommendations and report back to class. The Public Service Commission members are elected in state-wide elections. It is their job to regulate the public utilities. However, major contributions to their campaigns are received from the various utilities they regulate.

2. President of Giant Power Corporation - The Giant Power Corporation is a monopoly regulated by Public Service Commission. Its main objective, although it is called a "public utility" is to show growth and profit to its stockholders. The president's objective is to maintain his $100,000 a year salary and keep his powerful position by making decisions that increase profits for Giant Power Corporation.

To absorb losses caused by inflation or high crude oil prices is not an acceptable alternative. The Public Service Commission grants the Giant Power Corporation the right to a 9% profit. This the president aims to maintain.

3. President of the Chamber of Commerce - This person represents the business interest in TACO County. He is very interested in securing new industries for the county. He would be strongly against raising rates for business and industry even though that would make the burden of energy cost more equitable for all consumers. Chamber of Commerce members make sizeable contributions to Public Service Commission member's campaign treasuries.

4. Spokesperson for Consumer Groups - This individual representing several hundred people maintains that individuals should be be penalized for following Giant Power Corporation and governmental publicity to cut back on electrical usage by having their rates increased. His argument is that the heavy consumers - the commercial consumers - should pay a higher not lower rate than private or individual consumers since they are using a greater percentage of the electricity in a time of energy shortage than are the private consumers.

5. Woman on Welfare - This person, divorced, mother of 6, has no income other than welfare and the money she receives from ironing she takes in. She has had her electricity turned off twice and is again unable to pay her bill.

6. Retired Couple Living off Fixed Income - of social security and a small pension. These people moved to TACO County ten years ago when prices were within their budget. They were very proud of their small but modern all electric Gold Medallion home. They bring in receipts to the hearing to show how their bills have risen from $10 in February, 1965, to $110 in February, 1975. They cannot afford 1,000% increases in utility bills when their income is fixed.

7. Representative of apartment owners - who rent to winter tourists living in the county several months of the year. This person and those he represents argue that many semi-permanent winter residents will leave TACO County for other tourist - retirement areas because they cannot afford the increased utility rate, high deposit and high connect fee. He maintains that TACO County is a major tourist area, in fact, it was Florida's first, and that much money and many service jobs would be lost if the tourists left.

8. Widower living on $204 monthly Social Security - This person cannot now afford the base rate which amounts to $20 a month for his small one-bedroom house. He will have no choice but to have his electricity disconnected if rates are raised any higher.

9. Teacher earning $9,000 per year - This person argues that the Giant Power Corporation should absorb some of the increasing costs of fuel and not pass all of the expense on to the consumer. He points out that he was not permitted a 9% profit, in fact, he lost 10% in buying power last year because of no salary increase and inflation. After completion of role playing the issue and before the commission

reports its decision to the class:

a. Seek class consensus on the issue.

b. How does spectator consensus compare with Commission's consensus?

c. What values were involved?

d. What conflicts were apparent?

e. What difficulties are there in making decisions/policies?

f. What group, individuals or organizations have the most "power" in your opinion? Why?

g. How can the private consumer affect decision making?

h. What was not realistic in this exercise?

ACTIVITY 13:

This activity creates awareness of the problems with the allocation of energy. The activity develops this awareness in a realistic manner. Allocation problems are basically political problems. Authoritarian decisions are, for the most part, decided in favor of those groups that can produce the most political pressure. This activity is organized around a simulation-game based on this description of political decision-making.

Background: The description cited above is based on an elites model of politics. That is, political decisions are made for and by the elites of society. This is basically true because elites control the limited supply of political resources. For the purpose of this simulation, it is assumed that this is a realistic explanation of the political world.

The activity attempts to have students become aware of a dynamic process that has an effect on political decisions. The energy supplies, essential to carry on the day to day life of any community, will be drastically limited. The authoritative decisions made by governmental agencies will have profound impact on community life. To present complex developments (energy supplies and political conflict resolutions) in a relevant manner, a simulation-game was developed.

Day 1:

1. Begin the activity with a general overview of what the students will be doing for the next five days. The following points should be discussed:

   a. the students are going to examine the dwindling energy resources in the United States;
   b. the students will engage in a simulation-game that has them assume decision making roles in the year 2001. The roles will try to decide how energy is distributed in a small community;
   c. and, the students will engage in discussion activity that determines what they learned from the game and how they feel about it.

The teacher comments that the United States is faced with a drastic energy crisis. Students will be shown a film that demonstrates this situation and how it will be in the year 2000. The teacher then lists the ways students use energy everyday; for important things; for fun things.

Teacher writes the following questions on the board and tells students these will be discussed after viewing the film:

1. What is happening to the energy supplies?
2. What seems to be causing the changes in energy supplies?
3. How do you suppose this changing situation might affect your way of living when you become an adult?

Show the film (several are available; check with your media center). Discuss the questions on the board. Explain what decisions about energy will become more important. Government will become more involved in making such decisions.

Lead a discussion about how students will feel when the government decides how they will use energy. Teacher points out a useful idea in thinking about this issue of power. Teacher tells students that they are going to play a game that looks at how citizen power will determine who will get to use the energy available.

Homework assignment: There are 5 kinds of social power; coercive, reward, legitimacy, expert and referrent. Have students look up these words and describe 3 situations where they used different kinds of power.

Day 2:

Review the homework assignment and ask students to contribute the answers to the following questions:

1. what is (social) power?
2. what are the different types of power?
3. describe the different types of power.

Begin the simulation game by choosing five members of the class to make up a city council. Have them sit in a panel in front of the class. Announce that the panel represents a city council in the year 2001. The energy supply is very limited. In the year 2001, the class assumes that every community is given a certain amount of energy. In this simulation, the community starts with 2 million equivalent barrels of oil energy.

The teacher might demonstrate one round of the simulation. Hands out the role descriptions. Ask each student to read the role description they received. Students are informed that the city council (who also have roles) will be making decisions that will affect the student roles. With the roles the students receive power bills that represent the amount of power each citizen has in the community.

Hands out five issues for round one of the game. All issues must be decided yes or no. The way the issue is decided will either increase or decrease the power amount of each student. Each yes decision will also reduce the total community supply of energy.

Allow the class to read and study the first five issues. (5 minutes) Each council member votes by lifting either the yes or no card in front of them for each issue. Majority on the council wins.

Students should compare their role card for the code number and the issue description for the corresponding code number. On the issue description, the students is instructed how many power bills the student wins or loses as a result of the council vote. The student either adds or subtracts the appropriate number of bills according to the vote. Members of council also may win bills with a favorable vote on issues that affect them.

The teacher disperses and collects all winning and losing bills. Students can be trusted to hand in and collect the appropriate amount.

Day 3, 4, 5:

Ask the students if they are pleased with the way the council voted. If not, they will be able to elect three new members. Before the election, if will be useful to know what issues the next council will be voting on. Hand out the new set of five issues. The students should read and debate the issues.

Announce that it is time to elect a new council. To be a candidate for council, a citizen must give 50 power bills to announce his candidacy. Announcements are limited to 15 seconds and the first six students to buy "TV time" are allowed to be candidates. Students can get other students to donate bills in order to buy them.

When the six candidates are determined, they can make their 15 second speech. Additional time can be purchased for 50 power bills for 5 seconds. The teacher makes sure candidates only speak for the time purchased.

After each candidate speaks the class votes for a new council. The students getting the three highest number of votes win the seats. (Elections will proceed with 3 seats up for election, then 2 seats for election, then 3 and so on. Each campaign will allow 2 candidates per seat under contention.)

The new council votes on the five issues. The teacher then follows the following sequence:

1. subtract from the community's energy supply according to issues passed;
2. addition and subtraction of bills;
3. collection and dispersal of bills; dispersal of new issues;
4. buy "TV time;"
5. use "TV time;"
6. vote for council members;
7. council vote.

This sequence can go for 30 issues (6 rounds). The teacher may stop the activity after any sequence. If the community runs out of energy, everybody loses. If not, the student with the most power bills wins. A students who runs out "dies" and loses the game.

Day 6:

Teacher conducts a discussion session. The following questions are suggested:

1. After showing the students a list of issues that passed; what type of issues tended to win?
2. Did you have any complaints about how the council decided? Explain.
3. Who seemed to have advantages in getting their way?
4. What role did the TV play? Do you think it was fair? Explain.
5. What did those who were disadvantaged have to do to win a favorable council vote?

Assign short essays related to the objectives. Use the essays to evaluate the simulation and student progress.

ACTIVITY 14:

With the advent of the energy crisis and growing concern for meeting future energy demands Americans are faced with a new vocabulary.

In order to know what's happening, it is necessary to know the language of energy.

Cardboard or paper may be used to construct the energy bingo cards.

Draw bingo cards with six squares across and six squares down. Write the word E_1 N_1 E_2 R_1 G_1 Y_1 across the top of the cards.

Select as many vocabulary terms as you wish to be used under each letter. In this activity, only six terms were used for each letter. Vary this according to the number of cards you need.

Choose the number of cards you need, select 6 words at random for the cards. Vary the arrangement of the words so no two cards are the same. Write the words in the squares.

The bingo caller will read the definitions that have been written on index cards. The participant or participants will cover the word defined on his or her card. Covers may be made of cardboard or even paper clips.

The first person to get 6 words in a row or diagonally wins the game.

An example of the cards and energy related terminology and definitions are included. There are many variations that you may use. Students can make their own cards. You may have them look up the definitions or you may give them the words and definitions for study before the activity.

Example for the Bingo caller: Under E_1, Power, the force which makes things happen, the ability to do work.

Participants: Cover the word energy.

SAMPLE ENERGY BINGO CARDS

E_1	N_1	E_2	R_1	G_1	Y_1
ENERGY	MATTER	COOLANT	CRISIS	URANIUM	SCRAM
ENVIRONMENT	POLLUTION	CORE	PETROLEUM	KILOWATT	SMOG
POPULATION	POWER	CURIE	GEOTHERMAL	FOSSIL FUELS	PIG
FOOD CHAIN	ATOM	FISSION	SOLAR	HYDROPOWER	COLLECTOR
KINETIC ENERGY	BTU	FUSION	METHANOL	NUCLEAR ENERGY	PHOTOCHEMICAL VOLTAIC CONVERSION
POTENTIAL	CALONE	RADIO	TURBINE	PHOTOVOLTAIC CHEMICAL	MEGAWATT
ENERGY		ACTIVE		CONVERSION	

E_1	N_1	E_2	R_1	G_1	Y_1
KINETIC ENERGY	POLLUTION	RADIOACTIVE	GEOTHERMAL	NUCLEAR ENERGY	PIG
FOOD CHAIN	MATTER	FUSION	SOLAR	HYDROPOWER	COLLECTOR
POTENTIAL ENERGY	CALORIE	FISSION	CRISIS	KILOWATT	PHOTO - CONVERSION
ENVIRONMENT	POWER	CURIE	METHANOL	FOSSIL FUELS	MEGAWATT
ENERGY	BTU	CORE	TURBINE	PHOTOCHEMICAL	SMOG
				CONVERSION	
POPULATION	ATOM	COOLANT	PETROLEUM	URANIUM	SCRAM

ENERGY BINGO WORDS AND DEFINITIONS

E_1 VOCABULARY

1/ ENERGY = Power, the force that makes things happen, the ability to do work

2/ ENVIRONMENT = All of the things around us which affect us

3/ POPULATION = All of the persons, organisms or things in a certain place at a certain time

4/ FOOD CHAIN = The pathways by which energy passes from the first absorbing organism (plants) to animals and to humans

5/ KINETIC ENERGY = Energy possessed by objects in motion

6/ POTENTIAL ENERGY = Energy that is stored in matter because of its position

N_1 VOCABULARY

1/ MATTER = Anything that has mass and occupies space

2/ POLLUTION = The addition of any undesirable agent to an ecosystem

3/ POWER = The rate at which energy is used or generated. It is commonly measured in units such as horsepower or watts

4/ ATOM = The fundamental building blocks of chemical elements

5/ BTU = The amount of heat required to change one pound of water one degree fahrenheit

6/ CALORIE = The amount of heat required to change one kilogram of water one degree centigrade

E_2 VOCABULARY

1/ COOLANT = A substance circulated through a nuclear reactor to remove or transfer heat, usually water, heat or liquid sodium

2/ CORE = The central portion of a nuclear reactor containing the fuel elements

3/ CURIE = The basic unit to describe the intensity of radioactivity in a sample material

4/ FISSION = The splitting of a nuclear of an atom into two approximately equal parts accompanied by the release of large amounts of energy

5/ FUSION = The formation of a heavier nucleus by combining two lighter ones with the release of energy. The sun heats the earth by this method

6/ RADIOACTIVE = Describes something which gives off rays of energy and parts of the nucleus of atoms

R_1 VOCABULARY

1/ CRISIS = A dangerous time or event that will have an important effect on the future.

2/ PETROLEUM = Natural oil as it comes out of an oil well

3/ GEOTHERMAL = Having to do with the heat inside the earth

4/ SOLAR = Of or from the sun

5/ METHANOL = A colorless, poisonous liquid made from wood and other things such as garbage. It can be used as fuel.

6/ TURBINE = A type of engine which is turned by some liquid or gas hitting fan-like blades

G_1 VOCABULARY

1/ URANIUM = A radioactive element with the atomic number 92. It is the basic raw material of nuclear energy

2/ KILOWATT = 1000 watts - a unit of power

3/ FOSSIL FUELS = Fuels derived from the remains of organic materials, including petroleum, natural gas, coal, oil shale, and tar sands

4/ HYDROPOWER = Energy in stored or moving water

5/ NUCLEAR ENERGY = Energy within the nucleus of an atom, may be released by fusion or fission

6/ PHOTOCHEMICAL CONVERSION = A chemical reaction which converts light to useable energy

Y_1 VOCABULARY

1/ SCRAM = The sudden shut down of a nuclear reactor

2/ SMOG = A mixture of smoke and fog

3/ PIG = A heavy shielding container (usually lead) used to ship and store radioactive waste

4/ COLLECTOR = The component of a solar run system which collects solar radiation

5/ PHOTOVOLTAIC CONVERSION = The conversion of the light from the sun into electricity by means of solid state devices

6/ MEGAWATT = 1,000,000 watts or 1000 kilowatts

OBJECTIVE:

To identify local, state and national agencies through which an individual may work to change his environment.

ENVIRONMENTAL ORGANIZATIONS - NATIONAL

AIR

Air Pollution Control Association

a) One copy of Dictionary of Air Pollution Terms is available free of charge. Multiple copies are 10¢ and must be prepaid. Air Pollution Experiments for Junior and Senior High School Science Classes is $1.50 per copy and also must be prepaid.

b) Address: Air Pollution Control Association
4400 Fifth Avenue
Pittsburg, PA 15213

Clean Air Coordinating Committee

a) Coalition of over sixty community organizations. Research and action group focusing on air pollution.

b) Address: Clean Air Coordinating Committee
1440 West Washington Boulevard
Chicago, Illinois 60607

POPULATION

Planned Parenthood Federation of America, Inc.

a) Catalog of publications includes curriculum material Spanish publications, etc. Quantity discount.

b) Address: Planned Parenthood Federation of America, Inc.
810 Seventh Avenue
New York, N.Y. 10019

Population Reference Bureau, Inc.

a) Publishes Interchange, a Population Education Newsletter and Options, a Study Guide to Population and the American Future.

b) Address: Population Reference Bureau, Inc.
1755 Massachusetts Avenue, N. W.
Washington, D.C. 20036

Zero Population Growth

a) Publishes a newsletter, the ZPG National Reporter, and a magazine, Equilibrium.

b) Address: Zero Population Growth
4080 Fabian Way
Palo Alto, California 94303

WATER AND LAND

American Fisheries Society

a) N/A

b) Address: American Fisheries Society
1040 Washington Building
Fifteenth and New York Avenue, N.W.
Washington, D.C. 20005

National Association of Soil and Water Conservation Districts

a) N/A

b) Address: National Assoc. of Soil and Water Conservation Districts
1025 Vermont Avenue, N.W.
Washington, D.C. 20005

Water Pollution Control Federation

a) N/A

b) Address: Water Pollution Control Federation
3900 Wisconsin Avenue, N.W.
Washington, D.C. 20016

WILDLIFE AND ANIMALS

Izaak Walton League of America

a) Promotes means and opportunities for educating the public to conserve, maintain, protect and restore the soil, forest, water, and other natural resources of the U.S. and promotes the enjoyment and wholesome utilization of those resources.

b) Address: The Izaak Walton League of America
1800 North Kent Street, Suite 806
Arlington, Virginia 22209

CONSERVATION AND BEAUTIFICATION

American Conservation Association, Inc.

a) Works to preserve and develop natural resources for public use. Two brochures of free and inexpensive items available upon request.

b) Address: American Conservation Association, Inc.
30 Rockefeller Plaza
New York, N.Y. 10020

Garden Club of America

a) Environmental education packet, The World Around You, is available upon request. Includes study guide and 8 leaflets. One packet free to teachers; each additional $1.00, study guide 50¢ and leaflet 5¢.

b) Address: Garden Club of America
598 Madison Avenue
New York, N.Y. 10022

Keep America Beautiful, Inc.

a) Publishes a newsletter and acts as a clearinghouse for techniques and materials which can be used to reduce the litter fallout. New environmental action kit available.

b) Address: Keep America Beautiful, Inc.
99 Park Avenue
New York, N.Y. 10026

National Center for Resource Recovery

a) Provides fact sheets, bibliographies and slides.

b) Address: National Center for Resource Recovery
1211 Connecticut Avenue, N.W.
Washington, D.C. 20036

League of Conservation Voters

a) Packet of information, including chart of how Congressmen voted on environmental issues, is available upon request.

b) Address: League of Conservation Voters
324 C Street, S.W.
Washington, D.C. 20003

National Parks and Conservation Association

a) Publishes National Parks and Conservation monthly. $10/year with membership. $8/year with student membership.

b) Address: National Parks and Conservation Association
1701 Eighteenth Street, N.W.
Washington, D.C. 20009

Soil Conservation Society of America

a) Publishes the *Journal of Soil and Water Conservation*.

b) Address: Soil Conservation Society of America
7515 Northeast Ankeny Road
Ankeny, Iowa 50021

The Wilderness Society

a) Promotes preservation of wilderness and concern for the environment, in general.

b) Address: The Wilderness Society
729 Fifteenth Street, N.W.
Washington, D.C. 20005

National Audubon Society

a) Among the oldest and largest conservation organizations in North America. Its purposes are: (1) to promote the conservation of wildlife and the natural environment; and, (2) to educate man regarding his relationship with, and his place within the natural environment as an ecological system. *Audubon Aids* are materials that provide information and opportunity for discovery in nature.

b) Address: National Audubon Society
950 Third Avenue
New York, N.Y. 10022

National Wildlife Federation

a) To create and encourage an awareness among the people of this Nation of the need for wise use and proper management of those resources of the earth upon which the lives and welfare of men depend; the soil, plant life, and the wildlife. In addition to publishing National Wildlife, the Federation publishes numerous educational leaflets on conservation. Single copies of leaflets free. Write for list of publications.

b) Address: National Wildlife Federation
1412 Sixteenth Street, N.W.
Washington, D.C. 20036

GENERAL ENVIRONMENTAL PROTECTION AND INFORMATION

Boy Scouts of America

a) Informative, illustrated booklets on conservation available. Also, a directory of conservation agencies and organizations. Free

b) Address: Boy Scouts of America
Conservation Service
North Brunswick, N.J. 08902

Center for Study of Responsive Law

a) A watchdog of consumer interests, founded by Ralph Nader. Engages in pollution study.

b) Address: Center for Study of Responsive Law
P.O. Box 19367
Washington, D.C. 20036

Center for War/Peace Studies

a) A research, development and consulting agency concerned with education about our global environment. Puts out a great deal of material for classroom use, particularly at the secondary level.

b) Address: Center for War/Peace Studies
218 East Eighteenth Street
New York, N.Y. 10003

Citizens Committee on Natural Resources

a) Primarily concerned with environmental legislation. Write if you have questions in this area.

b) Address: Citizens Committee on Natural Resources
1346 Connecticut Avenue, N.W.
Washington, D.C. 20036

Concern, Inc.

a) Publishes *Eco-Tips*, a series of leaflets which cover air pollution and pesticides, energy conservation, etc. Single copies available upon request.

b) Address: Concern, Inc.
2233 Wisconsin Avenue, N.W.
Washington, D.C. 20007

Ecology Forum, Inc. -- Environment Information Center, Inc.

a) Publishes monthly *Environment Information Access* and annual *Environment Information Index*. Also the *Environment Regulations Handbook* and the *Environment Film Review*.

b) Address: Ecology Forum, Inc. -- Environment Information Ctr., Inc.
124 East 39th Street
New York, N.Y. 10016

Environmental Action

a) Inexpensive pamphlet *Do-It-Yourself Ecology* available. Puts out a bi-weekly, *Environmental Action*.

b) Address: Environmental Action
Room 731
1346 Connecticut Avenue, N.W.
Washington, D.C. 20036

Environmental Action Coalition

a) Major programs include "Trash is Cash" recycling program, Volunteer Speakers Bureau, young people's environmental newsletter (Eco-News) and teacher's environmental education workshops.

b) Address: Environmental Action Coalition
235 East 49th Street
New York, N.Y. 10017

ERIC

a) Publishes a free *Environmental Education Newsletter* eight times a year.

b) Address: ERIC
Information Analysis Center for Science, Mathematics and Environmental Education
400 Lincoln Tower
The Ohio State University
Columbus, Ohio 43210

Essentia

a) Formerly called Environmental Studies. Ideas and information on environmental teaching materials.

b) Address: Essentia
The Evergreen State College
Olympia, Washington 98505

Friends of the Earth

a) Student membership $7.50, regular $15. Includes monthly publication, *Not Man Apart*. Engages in political action for the protection of the environment.

b) Address: Friends of the Earth
529 Commercial Street
San Francisco, California 94111

League of Women Voters of the United States

a) Leaflets on facts and issues for air pollution, etc. available at discount rates. Your local chapter of the League may also be a useful information source.

b) Address: League of Women Voters of the United States
1730 M Street, N.W.
Washington, D.C. 20036

President's Environmental Merit Awards Program

a) All schools and youth groups, K-12, eligible to undertake a project to improve the quality of life in their community. Awards carry Presidential seal and signature.

b) Address: President's Environmental Merit Award Program
401 M Street, S.W.
Washington, D.C. 20036

Resources for the Future

a) Publishes findings and conjectures from recent research into environmental quality and resource development and use.

b) Address: Resources for the Future
1755 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Scientists' Institute for Public Information (SIPI)

a) Publishes *Environment*, a journal concerned with the effects of technology on the environment. Ten issues $10/year for non-members, lower rates for students.

b) Address: Scientists' Institute for Public Information SIPI
30 East 68th Street
New York, N.Y. 10021

The Sierra Club

a) To protect and conserve the natural resources of the Sierra Nevada, the U.S., and the world; to undertake and publish scientific and educational studies concerning all aspects of man's environment and the natural ecosystems of the world; and to educate the people of the U.S. and the world to the need to preserve and restore the quality of that environment and the integrity of these ecosystems. With 35 chapters coast to coast, the club's non-profit programs include wilderness outings, white water trips, skiing, mountaineering, knapsacking, films, exhibits, conferences, 14 huts and lodges, a library, and publishing.

b) Address: The Sierra Club
1050 Mills Tower
San Francisco, California 94104

The Sierra Club Foundation

a) A non-profit, tax-deductible, public foundation established in 1960 to finance the educational, literary, and scientific projects of groups working on environmental problems across the country. Parcels of land are owned and preserved. Special regional or interest funds may be established by individuals or foundations.

b) Address: The Sierra Club Foundation
220 Bush Street
San Francisco, California 94101

Sierra Club Legal Defense Fund

a) N/A

b) Address: Sierra Club Legal Defense Fund
311 California Street
San Francisco, California 94104

Small Towns Institute

a) Concerned with revitalizing small towns and countryside communities. Publishes monthly newsletter.

b) Address: Small Towns Institute
P.O. Box 517
Ellensburg, Washington 98926

GOVERNMENT ORGANIZATIONS

Specific governmental agencies have programs relating to the environment and can supply materials on their areas of interest. These include:

Bureau of Outdoor Education

Department of the Interior
Washington, D.C. 20240

Department of Transportation

Office of Environmental Policy, FHWA
U.S. Department of Transportation
Washington, D.C. 20591

Environmental Protection Agency

Public Affairs Office
Public Inquiries
Rockville, Maryland 20852

Publications include: EPA Citizens' Bulletin and Health Effects of Environmental Pollution.

Federal Extension Service

U.S. Department of Agriculture
Washington, D.C. 20250

Federal Water Pollution Control Administration

Crystal Mall Building 2
1921 Jefferson Davis Highway
Arlington, Virginia 22203

Fish and Wildlife Service

Office of Conservation Education
Fish and Wildlife Service
U.S. Department of the Interior
Washington, D.C. 20240

Food and Drug Administration

Office of Consumer Affairs
U.S. Department of Health, Education and Welfare
5600 Fishers Lane
Rockville, Maryland 20852

Forest Service

U. S. Department of Agriculture
South Agriculture Building
Washington, D.C. 20250

Geological Survey

Information Office
U. S. Department of the Interior
Washington, D.C. 20240

National Oceanic and Atmospheric Administration

U. S. Department of the Interior
Washington, D.C. 20240

National Park Service

U. S. Department of the Interior
Washington, D.C. 20210

Occupational Safety and Health Administration

U. S. Department of Labor
Office of Information Services
Room 1010 - 1726 M Street, N.W.
Washington, D.C. 20210

Office of Solid Waste Management

Publications Distribution Office of Solid Waste
Management Program
Environmental Protection Agency
5555 Ridge Avenue
Cincinnati, Ohio 45268

Soil Conservation Service

Educational Relations
Information Division
U. S. Department of Agriculture
Washington, D.C. 20250

U. S. Water Resources Council

2120 L Street
Washington, D.C. 20037

PROFESSIONAL AND EDUCATIONAL ORGANIZATIONS

American Home Economics Association

2010 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Publishes *Journal of Home Economics* and other materials. Request publications list.

American School Health Association

107 South Depeyster Street
Kent, Ohio 442240

The *Journal of School Health* is published 10 times per year for $15.

National Council for the Social Studies

1201 Sixteenth Street, N.W.
Washington, D.C. 20036

Publishes Social Education magazine ($10/year) a yearbook, etc.

National Education Association

1201 Sixteenth Street, N.W.
Washington, D.C. 20036

Publishes *Environmental Crisis: What You Can Do*, which tells how to help control pollution and lists resources. 30 packages are $1.50

National Science Teachers Association

1201 Sixteenth Street, N.W.
Washington, D.C. 20036

Puts out a catalog, *Environmental Education Materials*, which lists reviewed and evaluated free and low cost materials.

NATIONAL HEALTH ORGANIZATIONS

American Association for Health, Physical Education and Recreation

1201 Sixteenth Street, N.W.
Washington, D.C. 20036

Publications catalog includes items on environmental education.

American Cancer Society

New York City Division, Inc.
44 East 53 Street
New York, N.Y. 10022

Free literature distributed in New York City. In other areas, contact your local division.

American Lung Association (Formerly National Tuberculosis and Respiratory Disease Association)

15 East 26th Street
New York, N.Y. 10010

This is the national association. Contact them or your local chapter for catalog of free materials, including books, leaflets, films, posters, etc.

American Medical Association

535 North Dearborn Street
Chicago, Illinois 60610

Puts out periodicals of both a general and specialized nature. A listing of environmental films and a catalog of A.M.A. publications are available.

American Public Health Association

1015 Eighteenth Street, N.W.
Washington, D.C. 20036

Publishes a newspaper, The Nation's Health, and three other periodicals.

National Environmental Health Association

1600 Pennsylvania Street
Denver, Colorado 80203

Publishes the bi-monthly Journal of Environmental Health for $8/year. Single copies of their career information kits are free. Other brochures 5¢ each.

National Safety Council

425 North Michigan Avenue
Chicago, Illinois 60611

Catalog-Poster Directory is available upon request.

TRADE ASSOCIATIONS AND INDUSTRIES

The Aluminum Association

Manager of Educational Services
750 Third Avenue
New York, N.Y. 10017

Booklets, charts, filmstrip available free in classroom quantities or single copies depending on item.

American Association of Nurserymen

230 Southern Building
Washington, D.C. 20005

Information on environmental action program -- Green Survival -- and Career pamphlets available. Single copies free upon receipt of stamped, self-addressed envelope.

American Forest Institute

1619 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Inexpensive visual materials, a game, a booklet, a teaching unit and audio programs available.

American Gas Association

Educational Services
1515 Wilson Boulevard
Arlington, Virginia

Free booklet *Natural Gas Energy and the Environment* available.

American Iron and Steel Institute

150 East 42 Street
New York, N.Y. 10017

Informational booklets available, including *Steel - The Recycled Material.*

American Paper Institute

260 Madison Avenue
New York, N.Y. 10016

Several informational booklets are available, including *The Paper Industry's Part in Protecting the Environment*. Also, an experiment for children to try at home, "How You Can Make Paper." Films are available for club use.

American Petroleum Institute

180 K Street, N.W.
Washington, D.C. 20006

Edison Electric Institute

Educational Services
90 Park Avenue
New York, N.Y. 10016

Single copy of booklet of statistics, *Questions and Answers About the Electric Utility Industry*, available to teachers on request.

Glass Container Manufacturers Institute, Inc.

1800 K Street, N. W.
Washington, D.C. 20006

An extensive kit is available containing guidelines and background information for organizations interested in starting glass collections and recycling programs in the community.

Lead Industry Association

292 Madison Avenue
New York, N.Y. 10017

Booklet Lead and Zinc in the Environment available in classroom quantities.

Manufacturing Chemists Association

1825 Connecticut Avenue, N.W.
Washington, D.C. 20009

Several free pamphlets on the environment available. Puts out Chem-Ecology, a monthly newsletter.

National Soft Drink Association

1101 16th Street, N.W.
Washington, D.C. 20036

National Solid Waste Management Association

1145 19th Street, N.W.
Washington, D.C. 20036

Paperboard Packaging Council

1800 K Street, N. W.
Washington, D.C. 20006

Manufacturers of paperboard packaging. Publishes brochures.

The Soap and Detergent Association

475 Park Avenue South
New York, N.Y. 10016

Free pamphlet Soaps, Detergents and the Environment available.

The Society of the Plastics Industry

250 Park Avenue
New York, N.Y. 10017

Information on plastics recycling, incineration, reuse, etc.

Western Wood Products Association

1500 Yeon Building
Portland, Oregon 97204

A packet of booklets, Our Forests and You, is available for teachers.

ENVIRONMENTAL ORGANIZATIONS - STATE

Divers Against Pollution - Florida Skin Divers Association

a) To help fight the destruction of Florida's reefs, bays, wet lands, and water supplies and to conserve our natural resources.

b) Address: Mrs. Pat Thornton
Route 1, Box 268
Haines City, FL 33844

Environmental Committee - American Assoc. of University Women

a) To discharge the special responsibilities to society of those who have enjoyed the advantages of higher education; presently concentrating in the area of environmental presentations.

b) Address: Ms. Annette Moore, Chairperson
2487 Andros Lane
Ft. Lauderdale, FL 33312

Environmental Information - Center of Florida Conservation Foundation

a) To collect information, perform research and attempt to recommend solutions for environmental matters of Florida concern; cooperates with government, business, conservation groups, media, etc.

b) Address: William M. Partington, Jr.
935 Orange Avenue
Winter Park, FL 32789

Florida Association - Future Farmers of America

a) The development of angricultural leadership, cooperation and citizenship.

b) Address: Joe R. Kirkland, Executive Secretary
Division of Vocational, Technical & Adult Education
Knott Building
Tallahassee, FL 32304

Florida Audubon Society

a) To promote an understanding of and interest in wildlife, and the environment which supports it, and to further the cause of conservation.

b) Address: Hal Scott
P.O. Drawer 7
Maitland, FL 32751

Florida Bowhunter Council, Inc.

a) Preserve and promote bowhunting, sound biological game management, prudent progress and wise use of our natural resources.

b) Address: John Howell
810 Jacqueline Lane
Tallahassee, FL 32304

The Florida Chapter - Nature Conservancy

a) To obtain and save vital natural areas of the state.

b) Address: T. N. Anderson, President
1839 Miccosukee Road, Apt. 3A
Tallahassee, FL 32303

Florida Chapter - Sierra Club

a) To permit all men to explore, enjoy and cherish the wildlands that are their heritage while safeguarding a life enhancing environment everywhere on earth.

b) Address: Ellen Winchester, Chairperson
2405 Delgado Drive
Tallahassee, FL 32304

Florida Conservation Council

a) Twenty-seven resource interested organizations acting as clearinghouse for information.

b) Address: T. N. Anderson
1839 Miccosukee Road, Apt. 3A
Tallahassee, FL 32303

Florida Council for Clean Air

a) To investigate and work toward solutions to air pollution problems and other environmental hazards as they affect respiratory health.

b) Address: Carl C. Booberg, Secretary
P.O. Box 8127
Jacksonville, FL 32211

Florida Defenders of the Environment, Inc.

a) A coalition of volunteer specialists dedicated to the protection of environmental quality in Florida through preparation of special reports based on reliable information.

b) Address: Marjorie H. Carr
P.O. Box 12063
Gainesville, FL 32601

Florida Division - Izaak Walton League of America

a) To conserve, maintain, protect and restore the natural resources of the U. S. and Florida, including forests, soil, waters, air, and wildlife.

b) Address: Dr. Merrill G. Murray
Route 1, Box 81-H
Islamorada, FL 33036

Florida Federation of Garden Clubs, Inc.

a) To further the education of members and the public in the field of gardening, horticulture, botany, landscape design, conservation, beautification, and nature studies.

b) Address: Mrs. Sidney R. Davis
P.O. Drawer 8
Fort Myers, FL 33902 936-2704

Florida Federation of Zero Population Growth

a) To stabilize by 1990, the population through voluntary methods using educational, political and legal avenues. To increase public awareness of the consequences of population growth.

b) Address: Frank Flook
2027 Oak Street
Jacksonville, FL 32204

Florida Forestry Association

a) Non-profit, non-governmental organization of industries, businesses and individuals who encourage the promotion, development, conservation, and protection of Florida's forests.

b) Address: William Carroll Lamb, Executive Dir.
P.O. Box 1696
Tallahassee, FL 32302

Florida League of Anglers, Inc.

a) To take whatever collective action is required to prevent the demise of Florida's quality fishing.

b) Address: Lyman Rogers, President
P.O. Box 421
Ocala, FL 32686

Florida Outdoor Writers Association

a) Largest state organization of outdoor writers in America. Meets three times a year for clinics, workshops, and outdoor activities.

b) Address: Robert Wallace
1368 Marjon Avenue
Clearwater, FL 33516

Florida Trail Association

a) N/A

b) Address: James A. Kern
33 S. W. 18 Terrace
Miami, FL 33129

Florida Wildlife Federation

a) To further and advance the cause of conservation and environmental protection and to encourage the teaching of conservation to the public.

b) Address: John C. Jones, Executive Dir.
4080 N. Haverhill Road
W. Palm Beach, FL 33407

Garden Club of America - Zone 8 Representatives for Conservation

a) To aid in protection of native plants and birds, and to encourage civic planting.

b) Address: Mrs. Leonard Kirby
Box 248
Hobe Sound, FL 33455

Int. Game Fish Association

a) N/A

b) Address: Wm. K. Carpenter, President
3000 E. Las Olas Blvd.
Ft. Lauderdale, FL 33316

League of Women Voters of Florida - League of Women Voters of Florida Education Fund

a) Promoting active participation of citizens in government. Environmental concerns: physical environment beneficial to life; wise use of water resources; improved water and air quality; solid waste management; and land-use policies.

b) Address: Mrs. Sander Weinstock
324 Datura Street
W. Palm Beach, FL 33401

Organized Fishermen of Florida

a) Conserve the natural resources of Florida and promote the social and economic welfare of commercial and sports fishermen.

b) Address: Mary Barnes
P.O. Box 32
Bokeelia, FL 33922 (813) 283-0929

ENVIRONMENTAL ORGANIZATIONS - LOCAL

Environmental Action Group
J. Wayne Reitz Union
University of Florida 392-1635

Florida Defenders of the Environment
622 N. Main Street 372-6965
Mrs. Marjorie Carr

Florida Dept. of Agriculture and Consumer Services
Division of Forestry
Mike Bordyn, Alachua County Forester 377-7660

Florida Department of Natural Resources
Payne's Prairie
Don Yonkers 376-5069

City of Gainesville
Parks Division - Morningside Park
Phil Weinrich, Naturalist 377-1665

United States Soil Conservation Service
Farm and Rural Residence Land Use Planning
Lynn Kilpatrick, County Agent 376-7414

Alachua County Audubon Society
Steve Nesbitt 376-6481

Zero Population Growth
J. Wayne Reitz Union
University of Florida 392-1635

OBJECTIVE:

To identify environmental careers that an individual may pursue. The following is a listing of careers that are partially or wholly environmentally related.

A more detailed description of each career can be found in:

Career Education in the Environment, (Olympus Research, Washington, D.C.) These descriptions will be found in pages 2-26 through 2-113.

This book is part of the career education materials for the district.

I. Careers in Environmental Science and Research

  A. Life Scientists

    1. Aquatic Biologist
    2. Biochemist
    3. Biophysicist
    4. Biostatistician
    5. Cytologist
    6. Geneticist
    7. Microbiologist
    8. Pathologist
    9. Animal Ecologist
    10. Animal Husbandryman
    11. Entomologyst
    12. Pharmacologist
    13. Physiologist
    14. Zoologist
    15. Agriculturist
    16. Agronomist
    17. Botanist
    18. Forest Ecologist
    19. Horticulturist

  B. Physical Scientists

    1. Astronomer
    2. Chemist
    3. Analytical Chemist
    4. Inorganic Chemist
    5. Organic Chemist
    6. Geologist
    7. Assayer
    8. Geodesist
    9. Geophysicist
    10. Hydrographer
    11. Metallurgist, Physical
    12. Meteorologist
    13. Mineralogist
    14. Oceanographer
    15. Physicist
    16. Seismologist
    17. Soil Scientist

  C. Social Scientists

    1. Anthropologist
    2. Economist
    3. Geographer
    4. Mathematician
    5. Political Scientist
    6. Psychologist
    7. Sociologist
    8. Statistician
    9. Writer

II. Environmental Education and Technology

  A. Environmental Educators

    1. Camp Counselor or Recreation Manager
    2. Humanities Teacher
    3. Life Sciences
    4. Biology Teacher
    5. Physiology Teacher

6. Physical Sciences
7. Chemistry Teacher
8. Geography Teacher
9. Geology Teacher
10. Physics Teacher
11. Public Health Educator
12. Social Sciences Teacher
13. Vocational Teacher

B. Environmental Engineers

1. Aeronautical Engineer
2. Agricultural Engineer
3. Chemical Engineer
4. Civil Engineer
5. Combustion Engineer
6. Electrical or Power Plant Engineer
7. Environmental Engineer
8. Geological Engineer
9. Hydraulic Engineer
10. Industrial Engineer
11. Industrial Health Engineer (Safety and Sanitary)
12. Mechanical Engineer
13. Mining Engineer
14. Nuclear Engineer

C. Environmental Health

1. Field Health Officer
2. Industrial Hygienist
3. Physician
4. Sanitarian
5. Toxicologist

D. Environmental Planners

1. Architect
2. Landscape Architect
3. Urban Planner

E. Natural Resource Managers

1. Fish and Game Wardens
2. Forester
3. Oceanographer
4. Park Ranger - Naturalist
5. Range Manager
6. Soil Conservationist
7. Watershed Manager
8. Wildlife Manager

III. Environmental Technology and Implementation

A. Inspectors or Monitors

1. Environmental Inspector
2. Food and Drug Inspector
3. Health Inspector (Sanitation, Disease, Safety, Food & Drug)
4. Nuclear Inspector (Nuclear Waste, Radiation Level, Nuclear Safety)

B. Technicians

1. Biological Technician
2. Environmental Technician
3. Good Technician
4. Health Technician
5. Industrial Technician
6. Land Use Technician
7. Nuclear Technician
8. Physical Science Technician
9. Resource Conservation Technician

C. Testers or Analysts

1. Environment Tester or Analyst (Air, Water, Soil)
2. Mechanical Tester (Test Engine Evaluator, Sound Devices, Elec. Motor, etc.)

IV. Environmental Application and Operation

A. Laborers -- Attendants

1. Gardener
2. Incinerator Plant Attendant
3. Janitor
4. Refuse Collector
5. Resource Developer (Miner, Quarrying Personnel, Timberman, logger, oil field worker)
6. Wildlife Attendant

B. Operators and Foremen

1. Dumps and Solid Waste Disposal Operator
2. Incinerator Foreman
3. Incinerator Operation (Dumps, Solid Waste)
4. Power Plant Operator (Hydroelectric, Fossil Fuel, Nuclear, Stationary)
5. Recycling Operator
6. Water or Sewer Systems Foreman
7. Waste Water Treatment Plant Operator
8. Water Treatment Plant Operator

Although the preceding list is extremely thorough, the rapidity with which change in all fields occur makes it necessary to keep up to date. The following sources of information on environmental careers are arranged topically for greater utility.

ADDITIONAL SOURCES OF INFORMATION ON ENVIRONMENTAL CAREERS

Aeronautics

American Institute of Aeronautics And Astronauts, Inc.
1290 Avenue of the Americas
New York, N.Y. 10019

Agriculture

American Society of Agricultural Engineers
P.O. Box 229
Joseph, Michigan 40985

Air Pollution

National Air Pollution Control Administration
Box 12055
Research Triangle Park, N.C. 27709

Anthropology

American Anthropological Assoc.
1703 New Hampshire Avenue, N.W.
Washington, D.C. 20009

Architects

American Institute of Architects
1735 New York Avenue, N.W.
Washington, D.C. 20006

American Society of Landscape Architects, Inc.
2013 I Street, N.W.
Washington, D.C. 20006

Assoc. of College Schools of Architecture
521 18th Street, N.W.
Washington, D.C. 20006

Biology

American Institute of Biological Sci.
200 P Street, N.W.
Washington, D.C. 20036

Federation of American Societies for Experimental Biology
9650 Wisconsin Avenue
Bethesda, Maryland 20014

Chemistry

American Chemical Society
1155 16th Street, N.W.
Washington, D.C. 20036

Manufacturing Chemists' Assoc. Inc.
1825 Connecticut Avenue, N.W.
Washington, D.C. 20009

Conservation Education

Conservation Education Assoc.
c/o Secretary
1144 East 3rd Street
Salt Lake City, Utah 84102

Dietetics

American Dietetic Association
620 North Michigan Avenue
Chicago, Illinois 60611

Ecology

Ecological Society of America
c/o Secretary
Radiation Ecology Section
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831

Economics

American Economic Association
Northwestern University
629 Noyes Street
Evanston, Illinois 60201

Engineers

American Institute of Chemical Engineers
345 East 47th Street
New York, N.Y. 10017

American Institute of Industrial Engineers
345 East 47th Street
New York, N.Y. 10017

American Society of Civil Engineers
345 East 47th Street
New York, N.Y. 10017

American Society for Engineering Education
200 Pennsylvania Avenue, N.W.
Washington, D.C. 20037

American Society for Mechanical Engineers
345 East 47th Street
New York, N.Y. 10017

Society of Mining Engineers of the American Institute of Mining, Metallurgical, and Petroleum Eng.
345 East 47th Street
New York, N.Y. 10017

Fisheries Management

American Fisheries Society
1404 New York Avenue, N.W.
Washington, D.C. 20005

Forestry

U. S. Department of Agriculture
Forest Service
Washington, D.C. 20250

American Forest Institute
1835 K Street, N.W.
Washington, D.C. 20006

Society of American Foresters
1010 16th Street, N.W.
Washington, D.C. 20036

Geography

Assoc. of American Geographers
1146 16 Street, N.W.
Washington, D.C. 20036

Geology

American Geological Institute
2201 M Street, N.W.
Washington, D.C. 20037

Geophysics

American Geophysical Union
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037

Society of Exploration Geophysicists
P.O. Box 3098
Tulsa, Oklahoma 74101

Health

American Public Health Assoc., Inc.
1740 Broadway
New York, N.Y. 10019

Health cont.

Institute for the Study of Health
and Society
2199 North Decatur Road
Decatur, Georgia 30033

National Environmental Health
Assoc.
1600 Pennsylvania Street
Denver, Colorado 80203

National Sanitation Foundation
P.O. Box 1468
Ann Arbor, Michigan 48106

Medicine

Assoc. of American Medical College
2530 Ridge Avenue
Evanston, Illinois 60201

American Medical Association
535 North Dearborn Street
Chicago, Illinois 60610

Meterology

American Meterological Association
Second and B Streets, S.E.
Washington, D.C. 20032

Oceanography

American Society for Oceanography
845 Main Building
Houston, Texas 77002

American Society for Limnology
& Oceanography
W. K. Kellog Biological Station
Michigan State University
Hickory Corners, Michigan 49060

International Oceanographic Foundation
I Rickenbacker Causeway
Virginia Key
Miami, FL 33149

Office of Environmental Sciences
Smithsonian Institution
Washington, D.C. 20560

National Oceanography Assoc.
1900 L Street, N.W.
Washington, D.C. 20036

Outdoor Recreation and Parks

American Recreation Society
Room 622, Bond Building
1404 New York Avenue, N.W.
Washington, D.C. 20005

National Recreation Assoc.
8 West Eighth Street
New York, N.Y. 10011

Political Science

American Political Science Assoc.
1527 New Hampshire Avenue, N.W.
Washington, D.C. 20036

Resource Economics

Resources of the Future, Inc.
1755 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Resource Management

The Conservation Foundation
1250 Connecticut Avenue, N.W.
Washington, D.C. 20036

Sociology

American Sociological Association
1001 Connecticut Avenue, N.W.
Washington, D.C. 20036

Soil Conservation

Soil Conservation Society of America
7515 N. E. Ankeny Road
Ankeny, Iowa 50021

Technicians

National Council of Technical Schools
1835 K Street, N. W.
Room 907
Washington, D.C. 20006

U. S. Department of Health, Educ.
and Welfare
Office of Education
Division of Higher Education and/or
Vocational and Technical Education
Washington, D.C. 20202

Urban Planning

American Institute of Planners
917 15th Street, N.W.
Washington, D.C. 20005

American Society of Planning
Officials
1313 East 60th Street
Chicago, Illinois 60637

Water Pollution

Water Pollution Control Federation
3900 Wisconsin Avenue, N.W.
Washington, D.C. 20016

Wildlife Conservation and Management

The Wildlife Society
Suite S-176
3900 Wisconsin Avenue, N.W.
Washington, D.C. 20016

National Wildlife Federation
1412 16th Street, N.W.
Washington, D.C. 20036

OBJECTIVE:

To understand the interactive forces of each environment and how they interact to establish a state of equilibrium.

ACTIVITY 1:

1. Select a forest area to be studied. Identify six trees exemplary of a variety of growth patterns in the area. Obtain core samples from these trees. Obtain from some agency such as the Forest Service, 4" to 6" core sample of the type of tree to be studied. Have students:
   a. study structure of various cross-sections to obtain evidence of the history of the tree's environment (e.g., damage by fire or severe weather)
   b. study core samples for evidence of history of the environment (e.g., age of tree and rate of growth)
   c. form teams to select samples of two trees which show different characteristics to:
      (1) compare different environmental changes
      (2) compare different growth rates
      (3) infer the causes of different damages and different growth rates
   d. visit the forest from which the core samples were taken and:
      (1) locate the tree belonging to their core sample and compare their inferences with their actual findings in the forest
      (2) infer the way the area might have looked twenty years ago
      (3) predict how the area might look twenty years from now
      (4) describe how they feel about the change they envision taking place over the forty-year period
      (5) locate a stump or rotten log for careful study to:
         (a) look for evidence of change taking place
         (b) identify any cyclic processes that may be occurring
         (c) look for evidence in change which might give clues about the past history of the area
      (6) use natural items such as rotten wood, dandelion leaves, and dandelion flowers to construct a sketch of an area they consider significant
      (7) write on their sketch:
         (a) two broad descriptive words about their area
         (b) three action words about change taking place in their area
         (c) a four or five word phrase that will describe the usefulness or value of the area
         (d) one word that suggests a comparison, an analogy, or synonym about the area
      (8) share their sketches, writings, observations, and interpretations of the area

- (9) stake out an area one meter square to:
  - (a) predict what will be found in the top few centimeters
  - (b) sift through the top ten centimeters and record any evidence of plant and animal life they observe
  - (c) identify litter, duff, and humus and identify organisms found in each
- (10) locate an area suitable for a soil profile to:
  - (a) determine where the soil changes color and looks
  - (b) determine the color and texture of each layer
  - (c) determine the structure, temperature, and pH of each layer
  - (d) construct a soil micromonolith
  - (e) determine the slope of the land
  - (f) determine the air temperature just above the soil surface and one meter above the soil surface
  - (g) sketch a soil profile of the area studied and label the layers according to texture and depth
  - (h) feel and describe litter, duff, humus
  - (i) study information collected and compare it with charts exhibiting soil depth, topsoil condition, and color tables; determine what might grow in the area and compare predictions with finding in the area
  - (j) determine factors that contribute to soil formation
  - (k) locate evidence of geological change in the area
  - (l) determine factors that affect the uses of land
  - (m) use agricultural and land-use charts and other evidence in suggesting the best use of the area
- (11) use the soil data collected and tables to:
  - (a) determine the effect of soil depth on plant growth and water storage
  - (b) establish a relationship between soil color and soil condition
  - (c) establish a relationship between soil color and soil condition
  - (d) identify plants likely to grow in various pH ranges and soil conditions
  - (e) determine the length of the growing season and establish a relationship between growth rate and soil temperature
  - (f) identify factors affecting the use of land for various purposes and make recommendations for use of that land area

e. design an experiment to be carried out in a portion of his yard or in discarded containers for determining the results of depositing biodegradable materials in the soil - the experiment should make use of many types of biodegradable material such as newspaper, kitchen wastes, and yard materials and be designed to measure such items as:

- (1) change in soil texture
- (2) change in soil porosity
- (3) change in soil pH
- (4) change in organisms present in soil
- (5) rate of deterioration of biodegradable material

2. Display an official city or county map of an urban environment accessible for student study. Have students form teams of five or more members and let each team stake off a small area on the map they can conveniently study. Reproduce each selected segment so that each student has a map of the area he is to study. On the large map draw boundary lines around each area selected for study. Have each team:
   a. list the component parts of the environment and the things that might affect the quality of the environment in that segment. Write these in the appropriate areas on the large map.
   b. develop a plan of action for investigating the segment to determine cause and effect relationships between the items listed and the enviornment. Plan should include instrument and design for obtaining and recording information.
   c. visit their selected site to make observations and record information
   d. plan a presentation of their investigation which includes what they did, how they did it, and their conclusions about the environmental condition
   e. identify critical areas affecting the environment quality of the area and make suggestions, after having heard each team's report, for meeting the future needs of the area.

3. Provide students with a topographical map of the local area. Have students:
   a. locate a nearby body of water for study
   b. trace the origin of the body of water
   c. identify the boundaries of the watershed
   d. visit the area to:
      (1) observe and record observations about the total stream environment
      (2) collect aquatic specimens
      (3) use a guide book for pond life to identify specimens
      (4) use the evidence found with respective tables giving pH ranges that support various aquatic life
      (5) predict the dissolved oxygen content and pH of the stream based on the collection of living materials, a chart indicating the temperature ranges required for certain organisms
      (6) use water test kits to determine the water temperature, air temperature, dissolved oxygen count, and pH of the stream and compare results with predictions
      (7) determine stream flow
      (8) construct a cyclic flow chart of the interacting forces around the stream environment.
      (9) identify any problems that may prevent the normal cyclic interacting forces

(10) suggest ways of overcoming the existing problems which will be beneficial and acceptable to man

4. After an in-depth study of the various environments represented in the previous activities, have students:
   a. analyze the data collected for each environment and distinguish between similarities and non-similarities of the environment
   b. identify the basic functions of each environment
   c. identify the things that affect the quality of each environment
   d. identify the ways each environment interacts with each other
   e. summarize the unique contributions of each area to society
   f. describe guidelines to be used in determining future land use around these environments
   g. suggest guidelines to be used in determining future land use around these environments
   h. construct a flow chart to identify the energy-flow between the macro-environment, the mini-environment, and the micro-environment

How can man influence these forces in maintaining an acceptable environmental equilibrium?

1. Provide students with an activity for applying what they know to solve problems. The activity should consist of a series of sheets representing the topography of a land area to be studied and each subsequent sheet should supply additional information. Students should describe the area from the given information on the sheet. Suggested information for each sheet is as follows:

   Sheet (1) contour lines
   " (2) contour lines, three elevations, size of contour intervals, scale of kilometers, and direction
   " (3) contour lines, three elevations, size of contour intervals, scale of kilometers, direction, marsh grass, pine trees, hardwood trees, and stream
   " (4) contour lines, three elevations, size of contour intervals, scale of kilometers, direction, marsh grass, pine trees, hardwood trees, stream, paved roads, major highways, and railroads
   " (5) contour lines, three elevations, size of contour intervals, scale of kilometers, direction, marsh grass, pine trees, hardwood trees, stream, paved roads, major highways, railroads; and symbols for parking areas, school, hospital, house, multi-family housing, recreation areas, industrial complexes, and shopping facilities

   Have the students do the following activities:

   a. Sheet 1:
      (1) describe the design

(2) identify the bottom of the page
(3) suggest what each line represents
(4) distinguish between the high and low elevations
(5) determine the amount of elevation represented by the distance between contour lines
(6) identify the geographic directions from any point on the map

b. Sheet 2:

(1) locate the directions from any point on the map
(2) describe a "contour interval"
(3) identify the highest point on the map
(4) determine the elevation represented by the last contour line in the northwest corner of the map
(5) determine the number of square kilometers represented on the map
(6) determine the approximate distance in kilometers between two high points marked on the map
(7) determine the approximate distance between the two highest points
(8) determine, on the basis of the distance and the elevation, if the slopes are gradual or rather steep inclines
(9) make statements about other physical characteristics one might observe on an actual plot represented by this map

c. Sheet 3:

(1) determine the possibility of a stream being located where it is
(2) determine the direction the stream is flowing
(3) justify the location of the marsh grass on the map
(4) justify placing the pines on higher elevations than the hardwoods
(5) infer what animals might live in the environs as indicated
(6) infer the nature of the areas surrounding the one represented by this map

d. Sheet 4:

(1) determine the number of kilometers of highway represented on the map
(2) determine if the highway or railroad have a steep incline
(3) identify the directions of the routes of transportation

e. Sheet 5:

(1) using all the information provided by the preceeding sheets and what they know about the environment, pollution, and economics, plan a community of 5,000 people using the symbols given at the bottom of the page to indicate the locations for the features they represent (add additional symbols if desired to add additional features)
(2) determine if they would have planned this the same way if there were a larger city five miles downstream connected by the same highway

(3) compare their home community with the ones planned by classmates and determine the necessity for a change in their home community

2. Select an area of unused land about one or two kilometers square which is adjacent to an expanding urban area (city or town). Secure topographic maps of the area for study by students.

   a. Have students form teams to determine:

      (1) the population of the urban area
      (2) the demands on housing, jobs, transportation, and public utilities
      (3) the vegetation of the area
      (4) the economy of the area
      (5) location of shopping areas
      (6) educational needs
      (7) zoning regulations

   b. Have students suggest possible uses of the land if it were to be purchased by the urban area and classify these suggestions into several broad areas.

   c. Following the previous activity, have students select an area they wish to represent. Form teams and prepare a case for presenting their desires about the use of the land to the planning commission and the city, town or county council or board of supervisors.

   d. Select a council and a planning commission to hear the cases. Have students carry out all presentations at the council hearing and then ask the council to vote on the issue. Be sure that all major categories are presented to the council. Determine if the majority of the students agree with their council's decision.

   e. Have students analyze the presentation of their cases to determine if they could have build a stronger case for their planned use of the area.

   f. Have students compare the outcome of this organized planning for land use with what is taking place in their community.

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In addition to the sources which are cited in the credits, there are several other works that could be of tremendous value to the teacher. These works can provide excellent background material for any teacher, but would be of particular value to any social studies teacher wanting to include an ecology unit in a social studies course.

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Terry, Mark; Teaching for Survival, A Handbook for Environmental Education. New York: Friends of the Earth/Ballentine Books, 1971

These books are all paperbacks and are available either through the County Environmental Education Contact Person, Donna Strickland, Howard Bishop Middle School, or can be ordered or purchased inexpensively at a local book store.